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THE PHILIPPINE JOURNAL OF SCIENCE

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GRAMMITIS

By EDWIN BINGHAM COPELAND
Of the University of California

SIX PLATES AND ONE HUNDRED-EIGHT TEXT FIGURES

The genus *Grammitis* was established by Swartz. The first publication was in Schrader's Journal (1801) 17. I have not seen this, even as most writers seem not to have done, since the usual citation has been Synopsis Filicum (1806). Dr. Maxon sends me the sequence of relevant species in the Journal; it is the same as in the Synopsis. Here the genus is characterized in a key to the genera, page 3, and defined, page 21: "Capsulae in lineolis rectis, sparsis. Indusia nulla."

The first species listed is *G. linearis,* the same author's *Polypodium gramineum,* Prod. (1788) 130. This, being its first species, and being retained in it here, as it has been by all authors except J. Smith who have maintained the genus, must be its type species; and its name must be *Grammitis graminea,* a combination curiously never made until 1947. Swartz cites as another synonym *Asplenium angustifolium* Jacq. (1786); but this specific name does not apply to this species (I include it in *G. Billardieri*), and may not be resurrected for any species of the genus, being barred by *G. angustifolia* Hew., which is *Polypodium angustifolium* Sw.

The second species is *G. marginella,* also a *Grammitis* as I construe it. The fifth species is *G. serrulata* Sw., which is nearly related to the first two, and will have to be returned

to *Grammitis* by those who decline to recognize a genus *Xiphopteris*. It is much nearer to *Grammitis* than to *Polypodium*, as typified by *P. vulgare*. The same is true of the seventh species, *G. myosuroides*, however that be construed,–Cf. Maxon, Bull. Torrey Bot. Club 32 (1905) 74.

The third species, *G. lanceolata*, is also a relative, but is now regarded as the type of *Loxogramme*.

The remaining seven species of Swartz were included because of the simplicity of the genera definition. In the Index Filicum, they appear now as species of *Polypodium*, *Ceterach*, *Monogramma*, *Anogramma* and *Gymnogramme*.

The contemporaries of Swartz, Willdenow and Robert Brown, accepted *Grammitis* without other change than the removal of *Ceterach*. Kaulfuss was the first to restrict the genus to about the sense in which I use it, removing its most immediate relatives, *Cochlidium* and *Xiphopteris*, the status of which is even now an open question.

Blume kept together the species with entire and with pinnatifid fronds, and tried to maintain the distinction between *Grammitis*, with elongate sori, and *Polypodium*, with round ones. As many have since been forced to see, this is effectively impossible. Blume took the dilemma by both horns, frankly naming the same species in both genera in the same year, 1928.[1] Thus *P. hirtellum*, Enum. 123, is cited as a synonym of *G. pusilla*, Flora Javae 109; and *P. setigerum*, Enum. 123, of *G. fasciculata*, Flora Javae 112.

Presl, in his Tentamen, gave nominal respect to the genus, keeping in it type species, even this, however, in a section *Chilopteris*, while his *Eugrammitis* consisted mostly of species now ascribed to *Dryopteris* (in the sense of the Index Filicum). In a work of great value, his treatment of this genus is inept.

Fée, Genera 232, construed the genus as I do, excluding only *G. trifurcata*.

Almost anything can be ascribed to Sir William Hooker by appropriate choice of the citation, but his final judgment must be regarded as expressed in his Species Filicum, where *Grammitis* in the strictest sense is the simple-leaved section of *Eupolypodium*. This was likewise the treatment of the group by Mettenius, and is that of the leading recent and present

[1] As usually cited; but De Wit, Flora Malesiana Bull. No. 5 (1949) 140, states that the correct date of the pertinent fascicles of Flora Javae is 1829.

authorities, Diels, Christ, Maxon and Christensen. During this long period, only J. Smith, Historia Filicum (1875) 179, maintained *Grammitis* as a genus, and construed it strictly,– except for making another genus of its type species.

As I here construe *Grammitis,* it is characterized by simple, narrow fronds not articulate to the rhizome, typically entire but sometimes sinuate or shallowly crenate or lobed; normally free veins; exindusiate sori which are round or elongate, normally on the acroscopic branches of veins divergent from the costa; pedicel of the sporangium mostly of a single row of cells; tetrahedral spores containing chlorophyll; the rhizome paleate but the lamina not so. I believe this to be a thoroughly natural group; that is, I see no reason to suspect that it is not monophyletic.

As near relatives, as derived from *Grammitis,* I construe:

Loxogramme, a typically old-world genus characterized by anastomosing veins, in correlation with usually greater width of frond.

Glyphotaenium, a similar Andean derivative.

Cochlidium, Scleroglossum and *Oreogrammitis,* distinguished by synsori parallel to the costa.

For reasons already published, Philip. Jour. Sci. 70 (1939) 184, I regard *Grammitis,* so far as surviving species are concerned, as a genus of Antarctic origin, migrant thence in tertiary time. The most of the derived genera have evolved to generic distinctness where they now are; and in a general way I can fix the point of differentiation, in geography and in the parent genus. It is in the discretion of any pteridologist familiar with the facts to construe these as justifying either the recognition of these genera, or their return to *Grammitis.* These genera are far from coordinate in distinctness. *Loxogramme* stands secure; *Oreogrammitis* is too little known for final judgment. *Cochlidium* is precarious, and *Xiphopteris* is about equally so. Differentiation in New Guinea, parallel to that of *Xiphopteris,* has produced the species I call *Grammitis interrupta.* I feel sure that it is not *Nematopteris,* to which Christensen transfers it; but anybody so disposed may constitute it a genus. *G. Deplanchei* has been segregated as *Austrogramme.* This makes eight possible derived genera.

A ninth possible such genus, *Lomaphlebia* J. Smith, presents a classic problem of another kind. It was based on one species, *Grammitis linearis* Sw., which for me is the type of *Grammitis.*

When we make rules of nomenclature, we apply to the past our present ideas as to the procedure least productive of permanent confusion. Making such an application of a modern idea, I consider that from 1801 to 1875 the type of *Grammitis* was *G. linearis,* more properly to be called *G. graminea,* even though the idea of a generic type was generally unsuspected during that period. Being an old generic type, it could not then become the type of a new genus. The application of a rule which would make *Grammitis* a genus of two species, *G. graminea* and *G. turquina,* necessitating another name for perhaps 135 species, would be intolerable. To avoid this, I invoke my own principle of convenience, Univ. Calif. Publ. Bot. **16** (1928), and decline to recognized the generic distinctness of the two species mentioned. However, they do constitute a possible ninth recognizable derived genus.

There is a tenth such group, more distinct and definable than *Xiphopteris* or *Cochlidium,* but never proposed as a genus, that with black-bordered fronds, the only clearly recognizable group in the genus which betrays great age by its present distribution. I recognize it subgenerically as *Melanoloma.* There are rules which might make this be *Grammitis,* since it includes *G. marginella,* the only species of Swartz left in *Grammitis* by J. Smith, after the removal of *G. linearis.*

This will suffice as a general discussion of the derivatives of *Grammitis.* The subject will come up in detail as we come to the manifest points of departure of some of these genera.

We come now to a much tougher problem. It is in connection with the great group or groups of pinnatifid and pinnate tropical ferns which have almost always been called *Polypodium,* and more definitely *Eupolypodium,* that we encounter real difficulty in defining *Grammitis,* both in words and in the assignment of species. It is this difficulty, rather than the impracticability of distinguishing between round and elongate sori, which is responsible for the abandonment of *Grammitis* as a genus by most modern authors. By general consent, these ferns, although they conform to the verbal definition of *Polypodium* in the strictest sense, are really rather remotely related to it,–compare Christensen, Dansk Bot. Arkiv **5** No. 22 (1928) and my own discussion in Univ. Calif. Publ. Bot. **16** (1928) 105, 106. Like *Grammitis,* these ferns appear to be of Antarctic origin. However difficult it is to define this group, as distinct from *Poly-*

podium, in words and by the use of gross characters, it does not belong in a genus with *P. vulgare.*[2]

If this tropical group, represented by such familiar species as *P. cultratum* Willd. and *P. obliquatum* Blume, be removed from *Polypodium,* and defined in words as may be found practicable, it must have a name, or be broken up and then have several names. If its relatives with entire fronds be included, *Grammitis* must be the name of the whole great genus. If *Grammitis* be excluded, without being made to include *P. serrulatum* (Sw.) Mett., the oldest name becomes *Xiphopteris.* If *P. serrulatum* and its immediate relatives be included in *Grammitis* or be made to constitute a small genus (and *Cochlidium* be similarly treated), the next available name in order of age is *Amphoradenium.* This, properly, is a small group endemic in Hawaii, to which generic status may well be restored in any breaking up of the great group. After *Amphoradenium,* the next possible name is *prosaptia,* which is definable in words, but in practice shades into the greater, still residual group, as insensibly as do *Grammitis* and *Xiphopteris,* or more so. For this reason, as I long since pointed out, *Prosaptia* may eventually be construed as one of the very large genera. However, it has been my practice to construe it more arbitrarily and strictly. If this be done, the finally available name of a genus of some hundred species is *Ctenopteris.* My practice is to recognize *Xiphopteris, Amphoradenium* and *Prosaptia* as small genera. For immediate purposes, the point of this paragraph is that *Grammitis* is the oldest generic name except *Polypodium* for any of the plants in question.

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[2] When this manuscript was first completed, in 1939, it did not occur to me to question the place of *Grammitis* in *Polypodiaceae,* although the most of its peculiarities were already known. In 1940, Ching, Sunyatsenia 5 (1940) 201–268, restored for it Presl's tribal name, *Grammitaceae,* as that of a distinct family. Holttum, Trans. Linn. Soc. Bot. 53 (1946) 128, took the same stand, using the corrected name *Grammitidaceae.* In my Genera Filicum, p. 174, I was content with stating that "*Grammitis* (with its derivatives) is the most aberrant element in the family" (*Polypodiaceae*).

Mrs. Giauque, has recently studied the gametophytes of species of *Grammitis, Scleroglossum, Ctenopteris, Amphoradenium* and *Prosaptia,* and found them uniformly more like those of *Hymenophyllaceae* than of known *Polypodiaceae.* There is now no reasonable doubt that the group should have family status. I do not now venture to speculate as to its phyletic origin. Holttum suggests *Gleicheniaceae* as a source.

If the delimitation of *Grammitis,* with more or less entire fronds, against its indubitable relatives with pinnatifid or compound fronds is impracticable, *Grammitis* must include all of the latter except such as may constitute the small genera already mentioned, and other eventual segregates. Such a treatment is repugnant to me and will probably strike most botanists in the same way. For the present, therefore, I use an arbitrary definition, and exclude species normally cut half-way to the costa. It is likely that as the border-line species, not here treated, become better studied, some of them will be taken in. No such arbitrary definition will by itself be finally satisfactory; but I believe that there is a natural genus with approximately this definition. I have less confidence that a natural classification of the excluded species is practicable, but that is not the problem here.

My conviction is that these two large groups were differentiated prior to the northward migration, as long ago as the Miocene: *Grammitis,* as here construed, with typically entire fronds; and what, amending the definition of Blume and Kunze, but by no means adopting that of J. Smith, may be called *Ctenopteris,* with broader, pinnatifid to compound fronds. More tentatively, I postulate a third group of similar antiquity, with linear, pinnatifid fronds, to be called *Xiphopteris.*

While descent of several genera from *Grammitis* is reasonably clear, the immediate ancestry of *Grammitis* itself is not correspondingly so. I postulate emigration from Antarctica, probably in Miocene time, but have no idea as to the preceding history. As in the case of the *Hymenophyllaceae,* evolution to the present degree of definition, or to that at the time of emigration, may have occurred in Antarctica, or more or less completely elsewhere, in the more remote past.

The frequent occurrence of abnormal forked fronds in this family is some evidence of a remote ancestry characterized by dichotomy, as is the case to-day of *Dipteris* and *Platycerium. Grammitis,* and independently of it *Pyrrosia,* have not necessarily evolved through a pinnate condition before becoming simple. In the cases of *Asplenium, Cyclosorus* and *Tectaria* with simple fronds, we can postulate a pinnate ancestry with confidence. Among nearer relatives of *Grammitis,* this is true too of *Selliguea,* and of *Leptochilus* and *Dendroglossa.* But these present only an analogy, no real evidence at all, applicable to *Grammitis.* Because *Polypodiaceae* as a whole are plants with larger and pinnately compound fronds, we are disposed à priori

to assume such an ancestry for *Grammitis, Pyrrosia, Crypsinus,* etc. In the case of *Grammitis,* this assumption is especially reasonable, because it has indubitable and near relatives which are pinnatifid and pinnate,—*Ctenopteris.*

As to the historic (geologic) priority of *Grammitis* and *Ctenopteris,* they might be cognate, with a near common ancestor, or either might be descended from the other. The prevalence of dissected fronds in the family suggests *Ctenopteris* as the more primitive. The internal evidence seems to me to point the other way, but it has never been well studied. Acquaintance with most of the species of both genera gives me the impression that *Grammitis* is the more certainly monophyletic,—that, within the genus, the species are more certainly directly related. The only group within *Grammitis* definable otherwise and not in terms of geography, and evidently a phyletic unit, is *Melanoloma,* and it has no relatives in *Ctenopteris.* On the other hand, there are several small groups in *Ctenopteris* which give me the impression of being independent of the body of the genus and of one another, but related rather to species or less definite groups in *Grammitis.* This evidence is vague at present. If, with more material and more study, it becomes definite, it will follow that *Ctenopteris* is at least in part derived directly from *Grammitis.* In that case, another consequence will be that *Ctenopteris* cannot be regarded as a comprehensive genus; and that, since generic recognition of these minor groups is likely to be difficult, the whole genus may have to be included in *Grammitis.* This course has already been adopted by Ching.

In every group of plants, the stability of the characters (characteristics) accepted as diagnostic must be subjected to scrutiny. As to the generic characters of *Grammitis:*

The paleate rhizome is characteristic of *Grammitis,* and of all its near relatives. But the paleae are subject to a measure of suppression by crowded stipes, particularly by very hairy crowded stipes. This is well illustrated within what I now recognize as a single species, *G. fasciculata.* Throughout the genus, the size of the paleae serves as a more or less usable specific character. I used it as a principal criterion in describing *Polypodium heanophyllum,* Philip. Jour. Sci. 40 (1929) 310: "The paleae . . . are 4 to 5 millimeters long on *P. setigerum* (*G. fasciculata*), and very conspicuous, while on *P. heanophyllum* they are less than half as large, and visible at all only after the removal of a mass of stipe-bases." Careful study of

a great number of specimens has since satisfied me that the density of the hairy stipes and the size of the paleae are strictly correlated.

The complete obsolescence of the paleae was first affirmed on the basis of careful study of many specimens by Maxon, in the case of *Polypodium jungermannioides,* Proc. Biol. Soc. Wash. 52 (1939) 116. With his material, I have confirmed the fact. The plants being similarly small, and the hairy stipes likewise densely crowded, paleae seem again to be completely suppressed on *G. parva.* On its similar neighbor, *G. coredrosora,* they are minute but not really absent, which is true also of the American *P. yarumalense.* The Bornean *G. Havilandii* has paleae 2 to 3 mm long on lax plants with few fronds; but on individuals with densely congested stipes they are obsolete. *P. pseudo-poolii* was described as without paleae; but I suppose it to be a monstrous form of *G. Poolii,* which has vestigial paleae among the crowded stipe-bases. Thus the absence of paleae, a breach of the generic character, occurs in widely separated species, unrelated except as they belong in the genus, always induced in the same way.

Paleae do not occur on the fronds. This may be emphasized, because it seems to be true of *Ctenopteris* also. Tentatively, I suppose that the several species like *Ctenopteris* in form, which bear paleae on the lamina, are relatives, not of *Ctenopteris,* but of *Polypodium.* Paleae have been ascribed to the stipes of several species of *Grammitis.* As to this, it is easy to be deceived, because on species with elongate rhizomes and large paleae the latter are likely to stand up and surround the base of the stipe. However, it does occur that paleae are borne on the base of the stipe.

Hairs are permanently present on the laminae of most species, and are very variable. Some species perfectly glabrous as to mature fronds bear some hairs on juvenile fronds. On others, I have been unable to find them at all; with better material for the purpose, they might be detected. At any rate, hairiness is common, and has been lost by species and groups of species in every region.

Linear or lanceolate form and entire margin are typical, but undulate margins are not rare. Regularly crenate or inciso-crenate margins are rare, but characterize the group of *G. trifurcata.* Because it is uniform on the two collections known, the fine crenation of *G. Mariae* looks normal for the species. Lobed margins are likely to be irregular, as in *G. sumatrana*

and *G. loheriana*, indicating that they are in a sense abnormal. That the entire margin is primitive in the genus is indicated by the fact that, of the species characterized by other margins, young plants, as far as known, have them entire.

A conspicuous monstrous form is produced by the outgrowth of a part of the veins, beyond the general margin, each winged by laminal tissue. Such outgrowths are likely to be longer than the solid width of the frond. *G. ludens* is an abnormal *P. alpestre* Blume, deriving its name from these outgrowths. *P. pseudo-poolii* is regarded as a similar monstrous form of *G. Poolii*. It is likely that *P. inconstans* derives its name from its being abnormal individually rather than specifically. I have seen individual freaks of this kind on a considerable number of species, the outgrowths sometimes more than three times as long as the normal width of the lamina. This monstrous dissection of the frond by outgrowths has nothing in common with that which would be produced by incision of the margin, and I doubt its having any evolutionary significance.

As is common in the whole family of *Polypodiaceae*, forked fronds occur in *Grammitis* more often than in ferns of most other families, and this may reasonably be ascribed to remote ancestral influence, to descent of the family from dichotomously divided ferns of the type of *Dipteris*. I have seen individual forked fronds on most of the species well represented in herbaria. *G. trifurcata* owes its name to an abnormality of this kind. *Grammitis furcata* is forked commonly enough so that the name is not misplaced. *Polypodium furcatum* Desv. is too little known for judgment as to whether the abnormality is individual or specific. *Polypodium subdichotomum* Racib., *P. dichotomum* Brause, *P. fuciforme* Ros., and *P. alcicorne* Ridley all owe their names to the same kind of malformation, and their types are likely all to be individual freaks.

Free venation is a generic character, distinguishing *Grammitis* from *Loxogramme*, *Glyphotaenium* and *Dictymia*. Still, casual anastomoses are fairly common. The more ample the venation, the more common are anastomoses, but they are sometimes seen in species with strictly once-forked veins. The source of *Glyphotaenium* in *Grammitis* is indicated by a proneness to anastomosis. I have not been able to fix on any species or group as particularly related to *Loxogramme*.

Characteristically, the sori are borne in one line on each side of the costa, each sorus being on the acroscopic branch of a forked vein. Simple veins have been ascribed in error to a

number of species, but they really are simple in *G. furcata* in America, several Madagascar species, and the Malayan *G. Merrillii*. All of these are species with narrowly linear fronds. Although not all species with such fronds have simple veins, the correlation between width of frond and division of the veins is clear. There is no suggestion that the unforked veins indicate affinity between the species in different lands. Only in the Madagascar group, the simple veins are a common character of related species.

Variant in the other direction, there are species in every region except the far South with veins several times forked. The more numerous veinlets provide places for additional sori, besides the regular single row on the lowest acroscopic veinlets. If the veins are only twice forked, the sori usually conform in arrangement to the generic pattern, but where the veinlets are more numerous some of them are likely to be fertile, so that there are irregularly or regularly placed sori between the typical row and the margin. I can see no reason for such a correlation, but it is a curious fact that there are species in America, Polynesia and Malaya with plural rows of sori and ciliate paleae, ciliate paleae being otherwise very rare in the genus.

While the mature sori of many species are apparently orbicular, the receptacle is almost always more or less elongate. If this elongation is considerable, it shows of course in the form of the sorus, elongate also, in the manner responsible for the generic name. Receptacles which are points rather than lines are found in a small number of species with obsolescent fertile veinlets, not providing space for the typical elongation.

The exindusiate sorus is invariable in the genus.

The pedicel of the sporangium is always a single row of cells for the most of its length.

The tetrahedral spore is invariable.

Turning now to a brief consideration of the characteristics of species and subgeneric groups, many of these have already been mentioned, as deviations from the generic pattern; and the most of them may await the description of the individual species.

An elongate rhizome, with seriate but not necessarily remote stipes, is regarded as primitive in the genus. *G. tenella* of Hawaii has a remarkably long and slender rhizome. Stout, creeping rhizomes with rather remote fronds are common in New Guinea and nowhere else. The majority of species every-

where have the fronds approximate or fascicled. Between these two, no fixed line can be drawn, but a distinction is often practicable and useful.

The specific peculiarities of the paleae will be described with the several species. Their variation in size dependent upon crowding has been described. As a group, the Madagascar-African species have small paleae. Those of America also run small. Those of New Guinea and Malaya average comparatively large and broad. I have seen single or plural bristles on the tips of the paleae of several species, but these are usually too fugitive to be used for identification. Within the shades of brown, both paleae and hairs commonly darken with age, as was already known to Blume.

An enlarged ring at the base of the stipe, reminiscent of an articulation, is evident on a number of species, but not visible on the majority. It may never function as a zone of abscission. A plant half-buried among the epiphytes of the mossy forest has no occasion to cast its leaves, and the persistent dead remnants of the fronds improve the water-holding capacity of the whole epiphytic mass of vegetation. The non-functional articulations of the species which show them are to be regarded as vestigial, indicating an ancestry which cast its leaves as a protection against drought. *Ctenopteris* has species which cast their leaves, others with vestigial articulations, and still others which have lost them completely. They seem to be wanting on all of the small genera derived from *Grammitis*. *Polypodium* retains them, and they function. There is some correlation between them and the length of the rhizome; they are wanting on densely fascicled stipes.

In describing rhizomes, paleae, stipes, laminae and hairs, it is my practice to state their dimensions. These figures are to be accepted with some exercise of judgment. No species can be described except as far as it is known, and many species are known from a single collection, some from a single plant. Some are so well known that they provide a good idea of what variation may be expected of a species. As a general rule, there is a dependable proportion between the various members of a plant of a species. Large, strong plants have larger paleae and longer hairs, as well as longer stipes and laminae, than young or weak plants. The environment acts on *Grammitis* as on other higher plants; exposure to exceptional light and dryness can shorten a developing stipe, or congest the stipes if long endured, more than it influences other parts of the plant.

With the foreging qualifications, measurements of stipes and laminae provide usable data for the recognition of species. Some species of *Grammitis* endure exposure, are dwarfed by it, but still produce sori, and the dwarfs are subject to description as independent species. *Grammitis nana* is such a plant; its identity in normal development remains unknown. *G. pilosiuscula* was a stunted or depauperate plant redescribed from better material as *G. hirta*. Blume also redescribed *G. setosa* as *G. pubinervis*, using a more perfectly developed individual. Through the years, I accumulated a considerable number of dwarf specimens, most of which I have been able to identify in the course of this intensive study. The danger of multiplying synonyms by the description of dwarfs is incomparably less in *Grammitis* than in the *Hymenophyllaceae*.

The hairs of stipe and lamina vary from species to species and group to group, in abundance, persistence, size, color and texture, but provide easy and dependable criteria for recognition. Within the species as I leave it, they vary in size, density and persistence in *G. Hookeri;* but I probably leave it a collective species. The same is the case of *G. ciliata* in which I include forms hairy throughout and hairy only around the sori. The only comon difficulty in connection with the hairs is due to their lack of persistence in a considerable number of species. Glabrescent fronds have been described repeatedly as glabrous. Some species, like *G. Havilandii*, have characteristic mixtures of hairs. *G. jagoriana* bears large stellate marginal hairs and smaller solitary ones. The dense minute hairs of *G. microtricha* are almost invisible to the naked eye. Some of the very fine hairs of G. *kyimbilensis* are branched. Four species of New Guinea and Malaya have hairs with enlarged bases, which leave the stipes more or less rough as they fall off.

Considering their size, and that they are ferns of wet places, the fronds of *Grammitis* are remarkably thick. Even the few species described as membranaceous would mostly better be called herbaceous. A large part of the species are described as coriaceous, the descriptions based of course on herbarium specimens. In nature, some species are indeed coriaceous or chartaceous; far more commonly, they are thick, but too fleshy and of too open texture for coriaceous to be an appropriate term.

Entireness of margin has been discussed as a generic character, but it needs more specific attention. It is intimately

correlated with the venation. The veins being far apart, the margin of as narrowly linear a frond as that of *G. tenella* is sinuate; because of its narrowness, this makes the whole frond effectively sinuate. Species whose veins fall regularly considerably short of the margin have the latter truly entire. If strong veins reach nearly to the margin, the frond is usually widened at the point of approach, making the margin wavy. Developed vein-groups (veins several times forked) operate in the same way. Thus waviness of margin and number of veinlets are not independent, but are rather expressions of one character. A third descriptive item with the same basis,—scattered sori correlated with number of veinlets,—has already been mentioned. And there is still a fourth correlation, that of width of frond and number of veinlets. While broad fronds usually have several veinlets, there are exceptions; *G. Deplanchei,* a species peculiar in several other respects, has broad fronds and strictly once-forked veins.

Veins are conspicuous or not in varying degree. This depends upon the texture of the frond, and upon the development of a sclerenchyma sheath, more than upon the vascular tissues of the veins. In the absence of a sheath, veins are inconspicuous, even in thin fronds. Expressions like "avenia" and "venis absconditis" mean only that the veins are incospicuous on the herbarium sheet. Species like *G. knutsfordiana,* with venation standing out strongly from the surfaces, are most exceptional. In the majority of species, the venation is evident by transmitted light. My practice is to drive air from the frond by the free use of alcohol, and then to throw strong light through the frond. Some species still require removal of the hairs to make the venation clear, but very few are opaque enough to keep the venation obscure after this treatment.

It is obviously to be understood that statements as to the forking of the veins apply to fertile veins. Veins are always simple at narrow bases and apices. Sterile veins in broader parts of the frond may be simple where the fertile ones are forked; or, if forked, the sterile acroscopic veinlet may be longer than it would be if fertile. It is usually necessary to remove the sorus to determine the position and shape of the receptacle.

The position of the sorus on its veinlet, as basal or nearly so, medial, or terminal, is characteristic of many species, while others are surprisingly unstable in this respect. Any statement on this point should apply to the receptacle only. While the

sorus may become orbicular on a somewhat elongate receptacle, the degree to which the elongation of the receptacle results in that of the sorus is usually fixed enough to characterize the species. Where I leave round and elongate sori in a species, as in *G. Billardieri,* it is probably because my species-discrimination is imperfect.

The sori of a majority of the species are superficial. A large number of others have them slightly or moderately impressed. Even if not deeply impressed, their places may be marked by little elevations of the upper surface of thin fronds. Comparatively few species have them very deeply impressed or immersed. The pits fall then into two distant classes: They are broad, roundish or elliptic, open from the inception of the sori; or they are narrow slits, effectively closed until the maturing sporangia force the sides apart.

The sporangia are long-stalked. A few species have marked peculiarities of color of the sporangia or of the annulus, but information on this point is fragmentary. The usual number of cells of the annulus is 13 or 14. No larger number is characteristic of a species, but I have counted as many as 16 and as few as 10.

Indusia being absent, bristles on the sporangia can serve for their protection against water, perhaps otherwise. These bristles seem not to occur on the subantarctic group, nor on any species of Madagascar or America. Hairs among the sporangia may serve the same purpose for some American species. A majority of Polynesian species have bristly sporangia. In New Guinea and Malaya, their presence is so general that their absence on certain species may be regarded as due to their loss. As they are more or less deciduous, sometimes even caducous, their absence is not to be affirmed without careful examination of maturing sporangia. Their presence or absence usually characterizes a species; the only species on which I am sure that they may or may not occur is *G. adspersa.*

Besides their mere presence, these bristles characterize species by a variety of attributes, color, length, slenderness, etc., sometimes by their position on the sporangia. Most commonly, they are dark to black, shorter than the diameter of the sporangium, straight and rigid, borne singly along the sides of the annulus. More exceptionally, they may be pale, curved or hooked, binate or ternate, or almost a millimeter long. Their presence can usually be shown with a simple lens; but their absence must not be affirmed without examination with the microscope and at

the proper stage of development of the sporangia. The sori mature in sequence from the base to the apex of the frond, and it is common for these setulae to be in good condition at some higher place after they disappear near the base.

The evidence of present geographic distribution shows that *Grammitis* migrated from Antarctica by all three of the great possible routes,—New Zealand and Tasmania, South Africa and Madagascar, and the Andes. The absence of any species common to Polynesia and New Guinea suggests a possible fourth route, such as by Rapa. Also, the presence of *Melanoloma* in Polynesia but not in New Guinea suggests immigration to Polynesia by some route east of New Zealand; it is found in the Marquesas, which are believed to have been colonized by a number of other plants from antartic America. The Hawaiian *G. tenella*, which is not at home with its neighbors in the genus, may have come by this route. With these problematic exceptions, there is nothing to suggest any mixing of the emigrant streams anywhere north of Antarctica. Even the residual subantartic group of species is widely separated from the other groups, everywhere except in and east of Australia. The development of the genus in species is decidedly richest where the tropics were colonized by the New Zealand migration. More specifically and conspicuously, it is richest in New Guinea, where this migration first reached a great and diversified tropical area. A few New Guinea species are common to Malaya and the Philippines, but not one is known farther east.

With few exceptions, notably the setulose sporangia, the same variety of specific characteristics is found in all regions, indicating that these characteristics existed prior to migration from Antarctica. No positive characteristic marks all of the species of any great geographic area. There are negative features common to all species of an area, notably the absence of setulose sporangia in America and Africa, and the dark-marginate border, absent in New Guinea and Malaya.

The dark border is the only character which seems to identify a phyletic group common to more than one area. It is found in certain species of America, the Atlantic Islands, Madagascar and Africa, and Polynesia from Samoa to the Marquesas. This being only the subgeneric phyletic group which is definable otherwise better than geographically, is therefore the only group which I segregate from an otherwise geographic arrangement of the species. The geographic arrangement is convenient; but its real justification is the fact that it is the best possible ap-

proach to a phyletic arrangement. Since the grouping of the species by regions is natural (phyletic), and no species is common to two regions (considering Malaya and the Philippines as subregions), a necessarily artificial key to the species of the World would serve no purpose. I therefore segregate *Melanoloma,* and then present keys to the species of the several regions. For more convenient use, I provide also keys to the species of several Polynesian island groups, and to those of Java and the Philippines.

Correlation between the several structures of the plant has been emphasized throughout the preceding discussion. Collectively, these structures must be subject to interpretation in relation to the characteristic environment of the plant, the mossy forest. At present, though, this is impossible except in the most general way, because the ecology of *Grammitis* has yet to be studied. I have had a rather particular interest in the genus for more than forty years, and have collected it innumerable times, have tried in vain to establish it in culture near sea-level. But the mossy forest is ill developed back of San Ramon, the scene of the only comprehensive study of fern ecology. The climate of the mossy forest is described in Brown's Vegetation of Philippine Mountains, but not the reaction of the ferns to this climate. The mossy forest is cool to cold; light intensity is low; the substratum is wet, and the air nearly saturated.

In general, it is thus a place of slow physiological processes, slow transpiration, slow photosynthesis, slow growth, slow diffusion of the mineral food which at best is very scanty. *Grammitis* makes the best of these conditions by its size, its usual leaf-structure, thick but largely filled with intercellular spaces, conducive to free circulation of gas, and freest possible transpiration and photosynthesis. Its characteristic fern neighbors, the *Hymenophyllaceae,* are adapted to the same conditions by extreme thinness. But there come times when this forest is dry. The wet masses of moss, lichen and fern tide these times over if they are not too long. Finally, the mosses, the lichens and at least a part of the *Hymenophyllaceae* suspend their vitality and endure desiccation. *Grammitis* is then protected by its hairy covering. The fronds collapse and curl as they gradually lose their internal water. How far they can lose their water without permanent damage is not known, but their thickness must enable them to survive most of the periods of dryness.

No fern releases its spores into very wet air; the sporangia open only as they become dry. Wind and storm go together, and when the spores are released in the mossy forest there is likely to be no wind. Thus the spores are unlikely to be taken up into the atmosphere and carried afar. The appearance may be due in some part to paucity of collections, but it is certainly true that *Grammitis* is remakable for the limited range of a large part of its species. In this respect, it is in marked contrast with the related genus *Loxogramme.* Thus, a single species of *Loxogramme, L. Parksii,* ranges well over central Polynesia, found on islands where 14 species of *Grammitis* are known. *Loxogramme* is an epiphyte of the high forest and rain forest, far less humid than the mossy forest, where there is a real chance that the spores can be taken up into the general currents of the air. Such exceptional species of *Grammitis* as *G. knutsfordiana, G. sumatrana* and *G. fasciata,* which, whether epiphytic or terrestrial (they can be either), occur in openings in the forest, and are exposed by place, stature and habit to drier air and to the wind, are remarkable in the genus for their wide range.

In the gloomy mossy forest, it is usual to find many *Grammitis* species growing together. Christensen and Holttum list 17 species from Mt. Kinabalu. As many are found on the Gedeh-Pangeranggo mountain mass in Java. This number can probably be exceeded on almost any great New Guinea mountain. Even on small mountains, in this part of the world, if only they have any typical mossy forest, a number of species are always present. They are almost always mixed, one branch of a tree having two to several species. I know from repeated experience how easily one collects a mixture of species, evident only after examination hardly possible in the cold mist and rain which too commonly make the actual collection hasty.

Nothing is more probable than that hybridization occurs under such conditions. It may well be responsible for the uncertainty regarding several species of the Gedeh; doubt as to these was voiced by Blume, who described single specimens, and it is not yet completely solved. I have several times found single too aberrant individuals in my own otherwise uniform collections, and find hybridization suggested on my notes of four decades ago.

Every botanist knows how commonly a species, described from a single collection as clearly defined, acquires a penumbra as it becomes common in herbaria. Few *Grammitis* species

are common in herbaria; the most of them are still known by single collections, or by very few. How fast the change occurs with subsequent collection may be seen in Cristensen's recent paper on Papuan ferns, Brittonia 2 (1937) 303, reporting second collections of three species, with substantial modification of the description in each case. Considering the number of species and the fewness of collections, one might anticipate that as collections increase and supposed species are found to blend,—which happens in all large genera,—many species will be reduced, and their names become synonyms. My study of *Hymenophyllaceae* resulted in a great reduction in the number of recognized species. In the case of *Grammitis,* I anticipate rather that with future collection the number of recognized species will increase, that the distinct discoveries will materially outnumber the species found not to be distinct.

It has been my practice in monographing genera to make the work as conveniently useful as possible, by quoting the original publication of the species not reduced. In all large genera, the older descriptions are notoriously inadequate. Long after the days of ten-word diagnoses, large ferns were incompletely described because of incomplete material. The specimens of *Grammitis* have almost always been complete; but the real specific characters have too commonly escaped description, sometimes because too small for cursory recognition, more often, probably, because regarded as inconsequential minutiae. The failure to recognize the genus has been responsible for the inclusion in the descriptions of much matter of generic but not of specific significance, and the more or less consequent omission of significant facts.

A description may note a short, scaly rhizome, short hairy stipe, small narrow frond attenuate to both ends, obtuse apex, entire margin ciliate at least when young, forked veins, with sori on the anterior branches forming a line on each side of the costa;—and that may look like a description, but it applies not to one species but to one hundred. The remarkable thing about *Grammitis* is that the species hardly distinguishable by these general descriptions usually prove to be quite unlike when one sees the specimens. Thus, *Polypodium samoense* and *P. Whitmeei* were described by Baker nearly enough in the same terms so that Prantl identified the former as the latter,—I have in hand the signed sheet, so show that in this case a mixture was not responsible; but two species of so natural a genus could hardly look less alike. What authority this mono-

graph has depends largely on my independence of the published descriptions,—on the number of authentic specimens, types and isotypes, which it has been possible to consult. My treatment of the several great areas is not equally independent. In the study of the American species, I have followed Dr. Maxon. He provided the most of my material; and even where my presentation deviates from his, I regard him as authority on these species. My material of Madagascar and African species has not been ample, and I have had to be content, in large part, with following Dr. Christensen's clear treatment of them. Feeling that too many species have been described from the far South, and not having authentic material of the majority, I have specifically recognized less than the material in hand might have justified. Authentic specimens of a number of New Guinea species are at present beyond any man's reach. It is unfortunate that this is the region where an unprecedented wealth of material has demanded the description of the most new species.

In this study, I have had the use of my own herbarium and that of the University of California, and loans of their entire material in the genus from:

The Rijksherbarium, Leiden, by Director H. J. Lam. This loan, including most of Blume's types, was indispensable for the interpretation of the Malayan species. Citation is usually as "Herb. Lugd. Bat."

The U. S. National Herbarium, by Dr. W. R. Maxon; particularly rich in American material, but containing also the types of Brackenridge's Polynesian species.

The New York Botanic Garden, by Dr. C. L. Wittrock.

The Gray Herbarium (Harvard University), by Dr. C. A. Weatherby. The two preceding contain a considerable number of isotypes of species of which the types were not available.

The Philippine National Herbarium, by Dr. E. Quisumbing, now destroyed but then rich in local material, and with a number of types and isotypes from other lands.

The Singapore Botanic Gardens, by Dr. R. E. Holttum, containing, particularly, a wealth of Peninsular material which I had not suspected of existing.

The California Academy of Sciences, by Miss Alice Eastwood.

The Bernice Pauwahi Bishop Museum, of Honolulu.

Also, a comprehensive collection of New Zealand specimens, from Miss L. Cranwell, the Dominion Museum, Auckland.

Also, collections of a few particularly needed specimens from:

Professor H. Ito, Imperial University, Tokyo.

Director Doctor L. Diels, Berlin-Dahlem.

Miss D. A. Goy, Botanic Gardens, Brisbane.

Mrs. M. S. Clemens,—specimens from the high mountains of New Guinea.

To all of these gentlemen and ladies, I would express my sense of great obligation and my cordial thanks.

I have also to express the same sense and sentiment to: Dr. E. D. Merrill, for a great variety of assistance, particularly for the chance to study the phenomenally rich collection by Mr. C. J. Brass, of the Third Archbold Expedition to New Guinea.

Dr. W. R. Maxon, again, for assistance in assembling the literature, and for personal advice as to American species.

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Mr. A. H. G. Alston, of the British Museum of Natural History, for assistance which became essential when war made it impossible to secure loan of the key material of the genus. Mr. Alston has been at pains to make observations and comparisons for me, at Kew as well as at the British Museum, and has assisted me repeatedly in the understanding of little known New Guinea species.

Mme. Tardieu-Blot, Musée d'Histoire Naturelle, Paris, for attempts to locate the types of some most mysterious species.

Dr. Herbert F. Copeland, for assistance in the preparation of all drawings.

The University of California, for the use of its rich facilities, particularly for the photographic subjects of the accompanying plates.

THE AUSTRAL GROUP OF SPECIES

This is the least differentiated of the geographically defined groups of species. Although 20 specific names have been proposed for members of this group, the practice for many years was to treat it as a single species. This procedure was introduced by Dr. Joseph Hooker, who knew these ferns in the field as did nobody else of his time. It was followed by his father, and by Baker, by Diels in Die Natürlichen Pflanzenfamilien, by Christ, by Christensen, and down almost to to-day by Cheeseman who knew them intimately where they are most diverse, in New Zealand.

The idea underlying this practice is that they are (1) exceedingly plastic, individually adaptive and responsive to the environment; and at the same time (2) variable without definable limits within the group. To the plasticity is ascribed a range in size, form and texture, such as in other lands and in other groups would be regarded as justifying the recognition of an indefinite number of species. A wide range from complete nakedness to dense and various hairiness may be due in part to plasticity, but must also mark hereditary strains, which should be regarded as species unless they are demonstrably unstable, or intergrade too perfectly for definition.

It ill beseems the herbarium worker to oppose his judgment to the concensus of opinion of competent field workers in a group. On this ground, I first prepared my discussion of this group as one species, or doubtfully two. And if Christensen, after treating all other species as one, described *P. patagonicum* as distinct, still he is in this group as purely an herbarium botanist as am I. A number of the "species" have been described by other men with limited knowledge of the species previously described. On the other hand, two men, Colenso and Kirk, who knew these ferns in the field about as well as did Hooker and Cheeseman, have recognized plural species.

My personal conviction is that Colenso and Kirk were correct in principle; that, with any reasonable use of the term species, several should be recognized. However, I have been unable to come to any firm conclusion as to what, or how many, these are. The great number of collections in hand seem to represent at least six species, probably more. I have authentic material of seven of the described species, and of these three should be reduced. Being uncertain, I recognize four species with definite names, and must be content with indicating the probable synonyms and doubtful other species. *G. diminuta,* No. 29 of this treatise, is the fourth member of this group.

The group is characterized by weak, not dark hairs if hairs are present at all; veins once forked, with both branches elongate, an occasional second forking near the margin; elongate sori if there is room for them to be elongate; and naked sporangia.

The range of the group is circumpolar, with the occurrence in South Africa uncertain. Northward, it ranges to Valdivia and Queensland. There is also a report by Brause, Bot. Jahrb. **56** (1920) 178, of its presence in New Guinea

Key to the species

Fronds glabrous or nearly so.
  Frond up to 1 cm broad.
    Paleae up to 4 mm long (circumpolar) ..... 1. *G. Billardieri*
    Paleae longer (Lord Howe Island) ..... 29. *G. diminuta*
  Frond over 1 cm broad (Auckland Island) ..... 2. *G. crassa*
Frond hairy ..... 3. *G. ciliata*

1. GRAMMITIS BILLARDIERI Willd.

Grammitis Billardieri Willd., Sp. Pl. V (1810) 139.
Polypodium Billardieri C. Chr., Index (1906) 513, *non* R. Br.
Asplenium angustifolium Jacq., Coll. 1 (1786) 121, *non Grammitis angustifolia* Hew.
Polypodium gramineum Poir., Enc. V (1804) 511, *non* Sw.
Grammitis australis R. Br., Prod. Fl. N. Holl. (1810) 146.
Polypodium australe Mett., Polyp. No. 15 (1857) *non* Fée.
Grammitis magellanica Desv., Berlin Mag. 5 (1811) 313.
G. angustata Desv., Prod. (1827) 221.
G. rigida Homb. & Jacq., Voy. Pole Sud (1852) *pl. 2, fig. F.*
G. humilis Homb. & Jacq., ibid. *f. H.*
G. nana Brack., U. S. Expl. Exped. XVI (1854)1, *non* Fée.
Polypodium poeppigianum Mett., Polyp. No. 17 (1857).
Grammitis araucana Phil., Linn. 33 (1865) 304, *partim.*
Polypodium crassium Kirk, Trans. N. Z. Inst. 13 (1885) 232.

"G. frondibus linearibus acuminatis integerrimis soris planis, stipitibus pilosis.

". . . Habitat in Novae Hollandiae capite Van Diemen.

"Frondes tripollicares lineares integerrimae basi attenuatae apice acuminatae. Stipites pilosi breves. Sori lineares. Simillima praecedenti (G. lineari) tamen diversa: stipitibus pilosis, frondibus parum mayoribus et soris non immersis."—Willdenow, l. c.

The Herb. Lugd. Bat. contains one plant definitely collected by La Billardiere, with his identification as *G. linearis,* mentioned by Willdenow; and some others evidently of the same collection but not so stipulated. I do not try to cite the very many specimens seen, because nearly all are without complete data. The typical Australian plant is an epiphyte; rhizome short, with lanceolate, acute, brown paleae; fronds clustered, 8 to 15 cm long, 5 to 8 mm broad, narrowed to a rounded or subacute apex, decurrent to a stipe 0.5 to 3 cm long which is rather deciduously hairy or fibrillose; lamina thickly herbaceous, naked or nearly so. Essentially the same plant occurs in Tasmania, New Zealand and its islands, and antarctic American and its islands. American specimens run smaller, as do many from New Zealand.

FIG. 1

Confining attention first to those plants which seem clearly enough one species, it is a variable one, not merely plastic. The rhizome is usually appreciably elongate in New Zealand and America. The paleae are of various shades, and vary in size with the fronds, up to 4 mm long on large plants, shorter and relatively broad on small ones; fronds varying to sessile, usually naked, but sometimes slightly puberulent, especially at the base; margin entire or somewhat irregular, flat or deflexed, with or without a fine cartilaginous border; veins evident or invisible, the branches usually not quite reaching the margin, the tips slightly or not visibly enlarged; sori occupying part or all of the acroscopic veinlet, straight or curved, superficial or slightly impressed.

Throughout the southern range of the typical plant, and beyond it,—as collected repeatedly on Kerguelen Land,—are dwarf plants, the fronds down even to 1 cm long, oblanceolate-spatulate, rigidly coriaceous, broadly rounded at apex, glabrous throughout, the sori short and commonly confluent. These usually grow on rocks. There is no question about the plasticity of *G. Billardieri*,—that it can be dwarfed by exposure. But my belief is that there are also one or several dwarf species, distinct in other respects as well as in size. *Grammitis rigida* might be the name of such a species, but was never published except by illustration. *G. nana* Brack. is probably a dwarf form of G. *magellanica*, which I do not distinguish from G. *Billardieri*.

Polypodium crassium, from Stewart Island, was described as a dwarf, with elongate rhizome, broadly ovate fronds, with one sorus near the middle. It may well be a local species, but its author found the wide-spread one at lower levels on the same mountain. The specific name is probably a misprint; it has no evident relation to *Grammitis crassa* Fée.

Polypodium poeppigianum Mett. was distinguished by its author by enlarged intramarginal vein-tips, the veins of his *P. australe* being supposed to run to the margin,—which they may seem to do. It was ascribed to the Cape of Good Hope, collected by Poeppig, where no similar fern has been found again. Its published dimensions, shorter than broad, are an obvious misprint. Sims, Ferns of South Africa (1915) 271, conjectures that the report was a mistake, due to confusion with *Polypodium australe* Fée; but this seems hardly possible, since Mettenius provided an amply distinctive description. No other *Grammitis* is reported from the Cape.

G. araucana will be discussed briefly under *G. ciliata,* where will also be found other hairy "species" which have usually been reduced to *G. Billardieri.*

2. GRAMMITIS CRASSA FEE Plate 1.

Grammitis crassa Fée, Genera (1850–'52) 234, *plate 1.*

"Frondibus lineari-lanceolatis, crassis, opacis, basi in petiolum attenuatis; nervillis pinnatis angulum 40° cum mesoneuro metientibus, surculo squamoso, squamis magnis, lanceolatis, integris, acuminatis, fuscis; sporotheciis dorsalibus, ellipticis, saepe confusis; receptaculo lineari, longiusculo, rimaeformi; sporangiis crassis; annulo 12-13 articulato, crenis crassis, distantibus; sporis rotundatis, globulosis, nigrescentibus.

"Habitat in Nova-Hollandia nemorosis. (Lord Amkland.)

"Filix rigida; frondibus fasciculatis; mesoseuro robusto, siccitate flavescente.

"Dimensions, 15–17 centim, sur 15 millim de largeur; les receptacles atteignent 5 millim; les écailles, 10–11 millim. de longueur."

Without suspicion of the identity, I redescribed this, and will let my description follow:

G. gregis G. Billardieri rhizomate crasso adscendente, paleis fuscis usque ad 9 mm longis, basi 2 mm latis apice longe attenuatis dense vestito; frondibus sessilibus fasciculatis, 11 cm longis, 1 cm latis, acutis, basi decurrentibus, coriaceis, glabris, fuscis; costa valida, venis immersis, subremote furcatis, ramis elongatis, rarius iterum breviter furcatis; soris medialibus, superficialibus, usque ad 5 mm longis, sporangiis nudis.

FIG. 2

NEW ZEALAND: Auckland Island, Carnley Harbor, *1 B. C. Aston, comm.* Miss L. M. Cranwell, Auckland Museum. With this specimen is Miss Cranwell's note: "Field's specimens are 18.5 by 0.5 to 1.9 cm," evidently referring to another collection. There is also in the Gray Herbarium a specimen from T. Kirk, with the printed label "South Island," but no other data; its fronds are greener and less coriaceous.

After mistaking this for new, I became suspicious because of the appropriateness of Fée's name and of the dimensions. In Fée's form of presentation, "Lord Amkland" is the collector, but it is an unheard-of name; and in script it is easy to mistake *ua* for *m;* the word must have been Auckland. Hooker, Sp. Fil. IV 167, reduced *G. crassa* to *Polypodium australe,* and, among citations of locality, has "Lord Auckland's and Campbell's Islands, J. D. Hooker." Clearly enough, the type locality of

G. crassa is Auckland Island, beyond 50° South latitude. It is well characterized by the broad, stout and coriaceous, sessile, naked fronds. There are casual anastomoses of the veins.

3. GRAMMITIS CILIATE Colenso

Grammitis ciliata Colenso, Tasm. Jour. Nat. Sci. 2 (1845) 166.
G. pumila Armstrong, Trans. N. Z. Inst. 13 (1881) 341, *non* Sw.
Polypodium paradoxum Col., Trans. N. Z. Inst. 14 (1882) 336.
P. albosetosum Bailey, 3rd. Suppl. Q'land. Flora (1890) 94.
P. patagonicum C. Chr. Arkiv v. Bot. 10 2 (1910) 15.

"Plant, small, caespitose, submembranaceous, epiphytical. Frond, simple, linear-lanceolate, obtuse, much attenuated at base, sub-sessile, 1–2 inches long, 2–3 lines broad, margin entire, sub-revolute, and beautifully ciliated with white translucent hair; upper surface slightly, and lower thickly, villous, with long white hair; colour, light green; mid-rib, sub-flexuose, blackish. Sori, oval or oblong, large, thick and crowded. Root, fibrous and tomentose.

"Hab. On trunks of living trees, humid woods, Bay of Islands, in the mountainous district in the interior, five days journey W.S.W. from Poverty Bay, E. Coast; Dec. 1841.

Obs. A species, in affinity, very near G. australis, R. Br.; from which, however, it differs, in being villous and ciliated, in having its sori more prominent and crowded, as well as in its being a much smaller plant. The fine ciliated hairs on its margin present a most beautiful appearance in the livng plant, but unfortunately they fall off with the most careful handling."—Colenso, l. c.

I am treating this, like *G. Billardieri*, in a comprehensive sense, including in it all plants in the group which have really hairy fronds. New Zealand specimens are: *Eric Craig 88* in Herb. Univ. Calif. and Gray Herb., without definite source; *Brame s. n.*, U. S. Nat. Herb. sheet No. 137350, from Otira Gorge, Westland; Herb. Lugd. Bat. No. 908, 290 . . . 236, without more definite source; and the following from Miss Cranwell of the Auckland Museum: *Matthews 674, 675, Miss Starke s. n.* from Bay of Islands (type locality or region), *Hamilton* from Kaweka Mountains, and *Cheeseman* from Mt. Peel (Nelson, South Island), and from Hooker Valley, Westland. A part of the Craig collection fits the description exactly, having a short rhizome with clustered fronds, and even a rather densely short-ciliate margin. The Leiden specimen is also a good fit. Most specimens have creeping rhizomes, with approximate or rather remote fronds, and very sparsely ciliate margins. All are small plants, with obtuse fronds attenuate downward, with copious hairs around (and coming up through) the sori. As to hairiness elsewhere than about the sori, they vary.

If these are all one species, it is quite variable as to elongation of rhizome, width and texture of frond, and hairiness of surface. *P. albosetosum* is typical *G. ciliata;* Miss Goy of the Queensland Herbarium supplied my specimen. *P. patagonicum* is within the New Zealand range; its type collection is represented in U. S. Nat. Herbarium. *G. pumila* Armstrong is construed as a dwarf form of *G. ciliata;* I cannot appraise the correctness of this assumption. *G. araucana* was probably a mixture when described, as very sparsely hairy. *Philippi 131* in Herb. Lugd. Bat. is hairy, not sparsely so, and is referable to *G. ciliata;* while *No. 131a* is naked,—*G. Billardieri.* An objection to this interpretation is that the species was described as with forked fronds; these are usually features of single plants. At any rate, both *G. Billardieri* and *G. ciliata* evidently occur in Valdivia.

In describing *P. patagonicum,* Christensen placed emphasis on its annulus of 14 cells, as contrasted with only 11 cells as the common number of *G. Billardieri.* Fourteen is the commonest number on *G. ciliata* from all sources. Thirteen is next commonest. A larger number than 14 is rare; but I have found 16 on both New Zealand and Valdivia plants,—more than I have ever seen on any other *Grammitis.* However, this common count of 14 is not distinctive; 14 and 13 are the commonest numbers on *G. Billardieri* from various sources, including Patagonia, and a count less than 13 is unusual.

THE AMERICAN SPECIES

Key to the species

Fronds without dark margins.
- Veins connected by a submarginal vein.
  - Fronds 3 to 5 mm wide ..... 4. *G. graminea*
  - Fronds 1 to 2 mm wide ..... 5. *G. turquina*
- Submarginal vein wanting.
  - Veins simple.
    - Fronds firm, entire at base.
      - Fronds glabrous ..... 7. *G. furcata*
      - Fronds hairy ..... 12. *P. Sprucei*
    - Fronds herbaceous, toothed at base..... 8. *G. wittigiana*
  - Fertile veins forked.
    - Paleae wanting ..... 9. *G. jungermannioides*
    - Paleae present.
      - Veins once forked.
        - Fronds hairy ..... 11. *P. yarumalense*
        - Fronds naked
        - Frond linear-oblanceolate, up to 6 cm. long ..... 6A. *G. Proctori*

Frond narrowly linear, larger..... 6. *G. Tatei*
Veins twice forked.
Fronds entire or repand ..... 10. *G. parietina*
Fronds regularly lobed ..... *P. andinum*
Veins with several branches.
Sori superficial or nearly so.
Fronds entire or sinuate.
Stipe 5 to 7 cm long ..... 14. *P. trichosorum*
Stipe 0.5 to 3.5 cm long.
Frond linear ..... 15. *G. nesiotica*
Frond broader.
Stipe and margin hairy..... 16. *G. minuscula*
Stipe and lamina glabrescent ..... 17. *P. insidiosum*
Fronds lobed ..... 13. *G. trifurcata*
Sori immersed, venation reticulate..... *Glyphotaenium*

Fronds with dark margins: see page 253

4. GRAMMITIS GRAMINEA (Swartz) Copel. **Plate 2, fig. 2.**

Grammitis graminea (Swartz) Copel., Genera (1947) .210, *pl. 2B.*
Polypodium gramineum Swartz, Prod. (1788) 130.
Grammitis linearis Swartz, Schrader's Jour. 1800[2] (1801) 17; Syn. Fil. (1806) 21; Schkuhr, Krypt. Gew. 8, *pl. 7.*
Lomaphlebia linearis J. Smith, Hist. Fil. (1875) 183.

"Frondibus acuminatis integerrimis glabris, fructificationibus solitariis, surculo nudo. Jamaica."—Swartz (1788).

Rhizome short, creeping or suberect, paleae about 2 mm long, lanceolate, brown; stipes fascicled, about 2 cm long, 0.3 mm thick, densely clothed with exceedingly short pale-brown hairs ("hispidis," Swartz); lamina commonly 10 cm by 4 mm, attenuate to both ends, thinly subcoriaceous, sparsely and minutely ciliate, glabrescent; veins visible beneath, more prominent above, forked, both branches running into a marginal vein; sori on the acroscopic branches, elliptic or becoming round, somewhat impressed, Schkuhr's figure fails to show the distinctive venation, as does also a figure by Clute, Fern Bulletin **16** (1908) facing page 97.

FIG. 3

JAMAICA, very many specimens seen, and none from any other source. Specimens so identified from Cuba are *G. turquina.* Ignoring the venation, Hooker, Sp. Fil. IV 165, followed by others, referred here a British Guiana plant which is an unbranched form of *G. furcata, Mecosorus nudus* Kl.; and even the Javan *G. caespitosa,* to which the superficial resemblance is indeed remarkable.

The marginal vein of this species and *G. turquina* is unique in *Grammitis,* and moved J. Smith to make *G. graminea* the

type of a new genus *Lomaphlebia*, in spite of its being already the proper type of *Grammitis*.

5. GRAMMITIS TURQUINA (Maxon) Copel. **Plate 2, fig. 1.**

Grammitis turquina (Maxon) Copel., Genera (1947) 211.

Polypodium turquinum Maxon, Proc. Biol. Soc. Wash. 52 (1939) 115.

"*Grammitis*. Epiphyticum. Rhizoma parvum adscendens, paleis testaceis ligulatis subclathratis copiose onustum. Folia subpendula, usque ad 21 cm. longa, stipitibus filiformibus quam laminis multo brevioribus, fumosis striatis minutissime hirtellis; laminae anguste lineares, herbaceae, plerumque 10–15 cm. longae, 1–2 mm latae, basi attenuatae, simplices, integrae vel leviter repandae, decidue ciliolatae, alioque glabrae, nervo mediano et venis supra elevatis; venae admodum obliquae, acute unifurcatae, ramis ambobus venam submarginalem crassiusculam continuam adeuntibus, anteriori elongato nervo mediano subparallelo, sorum inframedium vel medium ellipticum ca. 1 mm longum unicum ferente, soris subremotis itaque utrinque uniserialibus."

CUBA: Oriente, Pico Turquino, *Ekman 14558*, type. Other specimens, all from the Sierra Maestra of eastern Cuba: *Ekman 5268, 7165; Leon 11160; Hamilton 2.*

In the U. S. Nat. Herb. and Herb. N. Y. Bot. Garden, I have seen all cited collections. As noted by Maxon (not quoted), the paleae are yellowish-brown, up to 2.5 mm long; stipes 1 to 3.5 mm long. The species is distinguished from *G. graminea* by more slender rhizome and stipes, conspicuously narrower frond, and thinner lamina. There is nothing to add to Maxon's description.

FIG. 4

6. GRAMMITIS TATEI Copel., nom. nov.

Cochlidium attenuatum A. C. Smith, Bull. Torr. Bot. Club 58 (1931) 307, *non Grammitis attenuata* Kunze.

"Rhizomate erecto, dense paleaceo; stipitibus caespitosis, subteretibus, brevibus; frondibus simplicibus, coriaceis, linearibus, basi attenuatis, apice subacutis, margine plano; venis immersis, alternis, partium sterillium simplicibus, partium fertilium furcatis; coenosoris oblongis, venarum furcas superiores occupantibus."

"Rhizome . . ., the scales hidden among the leaf bases, pale brown, lanceolate-acuminate from an oblong base, 2–3 mm. long, about 0.5 mm. broad at the base, the tip short-pilose; . . . stipes . . . less than 4 mm. in length, the lamina . . . 8–12 cm. long, 1–1.5 mm. broad, . . . rarely forked near the apex; . . . coenosori . . . 1.5–2 mm. long, usually not confluent . . ."—Smith, l. c.

Mt. Duida, alt. 5,500 to 6,000 feet, *Tyler-Duida Exped. 428.* Cited also from Mt. Roraima, *im Thurn 166* and *365.*

The sheet of *Tyler-Duida Exped. 480* in Herb. N. Y. Bot. Garden bears an excellent specimen of *No. 428,* the type collection of this species, collected by G. H. H. Tate. Smith's description is good, except for one important word. The sporangia are in simple sori of the elongate form typical of *Grammitis,* not in coenosori, which would be formed by the fusion of these simple sori. They are superficial or slightly immersed. The fertile veins fork at a very acute angle, the sorus being of course on the acropetal branch. As in its immediate relatives, the frond is glabrous. The forked fertile veins distinguish it from *G. furcata.*

FIG. 5

6A. G. PROCTORI sp. nov.

G. rhizomate adscendente, paleis manifestis brunneis lanceolatis acuminatis ca. 1.5 mm longis vestito; stipitibus nullis vel brevissimis; frondibus congestis, plerisque 35 mm longis 3–4 mm latis, maximis 6 cm longis 4 mm latis, anguste oblanceolatis, obtusis, deorsum angustatis, glabris, rigidulis sed haud crassis; venis inconspicuis, furcatis ramis ambobus elongatis; receptaculis 1–1.5 mm longis, soris costae quam margini propioribus, late ellipticis.

JAMAICA, "East slope of the John Crow Mts, ca. 2 miles southwest of Ecclesdown, elev. 2,000 feet. Frequent epiphyte in mossy cloud-forest." *L. George R. Proctor 5642.*

The specimen consists of 5 uniform plants; wherefore, there is no reason to regard it as a dwarf form of any larger species.

7. GRAMMITIS FURCATA Hooker and Grev.

Grammitis furcata Hooker and Grev., Ic. Fil. (1828) *pl. 62;* Hooker, Genera *pl. 72B, fig. 1–6;* J. Smith, Hist. Fil. *pl. 11d*
Polypodium furcatum Mett., Polyp. (1857) 34, *non aliorum.*
Cochlidium furcatum C. Chr., Dansk Bot. Arkiv 6[8] (1929) 30.
Polypodium Connellii Baker, Trans. Linn. Soc. Bot. 6 (1901) 82.
Cochlidium Connellii A. C. Smith, Bull. Torrey Bot. Club 57 (1930) 179.
Polypodium dicranophyllum C. Chr., Index (1905) 331–522.

"Fronde lineari glabra furcata, apice obtusa, stipite nullo, soris oblongis oblique parallelis.

"Hab. Guiana. C. S. Parker.

"Radix parva, caespitosa, e fibris plurimis fuscis descendentibus.

"Frondes plurimae ex eaden radice, erectae, lineares, quattuor ad quinque uncias longae, duas lineas latae, medium versus simpliciter furcatae, margine integerrimae, subsinuatae, apicibus obtusis, inferne attenuatae,

sed stipes nullus. Substantia coriacea, medio costata, nervis simplicibus obscuris, oblique parallelis, sorigeris.

"Sori, in laciniis furcarum, oblongi, tumidi, simplici serie costa utrinque, dispositi . . ."—H. & G., l. c.

Paleae up to 5 mm long, castaneous, attenuate and sometimes crinite; fronds densely tufted, simple or forked, variable in width (the simple fronds), commonly about 2 mm wide, straight or sinuate, somewhat coriaceous; costa conspicuous, sterile veins remote and inconspicuous, at an acute angle to the costa, not approaching the margin; fertile veins simple, ending in an elongate receptacle almost parallel to the costa; sori large, over-reaching the margin and givingthe frond a nodulose appearance.

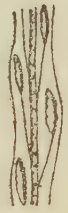

FIG. 6

Trinidad to the Amazon Valley. Besides the specimens cited by Christensen (1929), many of which I have seen, *Luetzelburg 23642* and *23718,* from Amazonas, may be cited.

P. Connellii, compared with *G. graminea* but not with *G. furcata* in the original description, is supposed to be distinguished by short-stipitate, simple (unforked) fronds, but neither of these criteria are constant; in fact, any wingless stipe is exceptional. The U. S. Nat. Herb. contains, as *P. Connellii, McConnell* and *Quelch 570* (cited by Baker), and *Tutin 526. Spruce 2452,* cited as *G. furcata* by Fée (*teste* Maxon), Hooker, Sp. Fil. IV 174, Baker, Flora Bras. I 507, and Christensen (1929) 20, belongs here; also *Ule 8515,* from Roraima, in Herb. Lugd. Bat.

Ule 8359 in Herb. Lugd. Bat., from Brazil (Rio Branco, Serra Marary), is peculiar in having extra-medial sori not surpassing the margin nor reaching the costa; it may represent a distinct species.

Mecosorus nudus Kl., type of the genus *Mecosorus,* is apparently *G. furcata,* though more commonly otherwise construed.

The venation of *G. furcata* is not duplicated by any other species of the genus, although there are Madagascar species with simple fertile veins. Still it is not unnaturally correlated with the extreme narrowness of the fronds,—though *G. tenella* and *G. ligulata,* with comparably narrow fronds, do still have forked fertile veins. Any argument in favor of the transfer of this species to *Cochlidium* is to me a more valid one in favor of ceasing to recognize that genus.

8. GRAMMITIS WITTIGIANA Fée and Glaz.

Grammitis wittigiana Fée and Glaz., Crypt. Vasc. Bras. **II** (1872–'73) 50, *pl. 95, fig. 1.*

Polypodium wittigianum Christ, Schwacke, Pl. Nov. Min. **II** (1900) 19 *quoad nomen;* Hieron. Hedw. **44** (1905) 88; Maxon, Cont. U. S. Nat. Herb. **17** (1914) 406.

Grammitis muscosa Fée, Crypt. Vasc. Bras. **II** 51, *pl. 95, fig. 2.*

Polypodium muscosum Christ. *non* Vahl.

"Frondibus simplicibus, linearibus, obtusis, glabris, marginibus dentatis, dentibus obtusis; mesoneuro fusco, rigido; nervillis simplicibus, margines non attingentibus, leviter arcuatis, fuscis, superficialibus; sporotheciis crassis, ovoideis, costalibus; sporangiis latis, parvulis, annulo angusto, 10–12 articulato, sporis fuscis, rotundatis laevibusque.

"Habitat in Brasilia fluminensi ad Itatiaia. (Glaziou, no. 5300; altitude 2300 metres.)

"Filix parvula, translucida, linearis, caespitosa.

"(Longueur, 5–7 centim. sur 5 millim. de largeur.)

"Cette espèce diffère de la prècèdente par des marges dentées ou ondulées, mais non crènulées; elle est deux à trois fois plus petite, translucide et non opaque."—Fèe, l. c.

Paleae about 1.2 mm long, broadly lanceolate, pale-brown; stipe up to 2 cm long, but usually winged to the base; lamina up to 10 cm long by 4 mm broad, usually entire in the upper (fertile) half, sinuate-crenate in the lower, glabrous, herbaceous; veins evident, simple, remote, not approaching the margin, ending under elliptic hydathodes; sori on subcostal receptacles which can occasionally be seen to project from the upper side of the vein as if on obsolete branches, costal at maturity.

FIG. 7

G. witttigiana may be regarded as representing the beginning of the evolutionary line leading to *Xiphopteris.* The type of Kaulfuss' genus *Xiphopteris* is *Grammitis serrulata* Sw., and will bear that name if *Xiphopteris* be not recognized. It is not near to *Polypodium,* under which name Maxon, Cont. U. S. Nat. Herb. **17** (1914) 398, has treated the American species comprehensively and well.

9. GRAMMITIS JUNGERMANNIOIDES (Kl.) Copel.

Grammitis jungermannioides (Kl.) Copel., Genera (1947) 211.

Polypodium jungermannioides Kl., Linnaea **20** (1847) 373; Maxon, Proc. Biol. Soc. Wash. **52** (1939) 116.

P. Fawcettii Baker, Jour. Bot. **27**(1889) 270.

P. dendricolum Jenman, Gard. Chron. III **16** (1894) 467, *teste* Maxon.

P. Sprucei var. *furcativenosa* Hieron., Bot. Jahrb. **34** (1904) 499.

"Frondibus caespitosis, erectis, parvis, ligulatis, obtusis, leviter repandis, versus basin attenuatis, undique sparsim rufescenti-pilosis; rhachi stipi-

teque brevi nigricante; venis pinnatis, ramis subinde ad apicem breviter furcatis; soris mediocribus, flavido-fuscescentibus.

"Frondes densissime caespitosis, tenues, membranaceae, 1½ pollices longae, infra apicem 1½ lin ad basin ½ lin. latae; Stipites filiformes pilis rufis patentibus dense obsitae, 2 lin. longae.

"Ad truncos arborum in sylvis humidis (reg. alp.). Merida Columbiae, Moritz n. 312."—Klotzsch, l. c.

Doctor Maxon precedes me in the study of this species, and my own study is almost entirely with his material; wherefore, I am pleased to be able to do as much as to confirm his findings.

FIG. 8

The rhizome is short, and its surface is occupied by the actual bases (not the lower parts) of the densely crowded stipes. Among these, no paleae can be detected, and indeed there is hardly room for any. A few roots squeeze out between the lower ends of the stipes. The absence of paleae is so remarkable that I have followed Maxon in looking for them very carefully. Large fronds are 10 cm by 3.5 mm; a common size is 5 cm by 2.5 mm; and fertile dwarfs (*Standley* and *Torres 47492,* Costa Rica) are as small as 10 by 1.5 mm; stipes from very short up to 2 cm, slender, densely clothed with cinnamon hairs about 1 mm long; lamina rounded at apex, long-attenuate downward, the sides straight or undulate,—dilated opposite the end of each vein,—more sparsely and less permanently hairy than the stipe; veins forked well above the base, the acroscopic branch the shorter, the elongate receptacle well above its base; sori medial, superficial, becoming roundish.

For citation of specimens, I refer to Maxon, adding *Brade 296,* Costa Rica, received as *Polypodium Sprucei* var. *costaricense* Christ. Christensen, Index 536, gives the range as Chile to Guatemala, to which Jamaica and Haiti must be added.

10. GRAMMITIS PARIETINA (Kl.) Fée

Grammitis parietina (Kl.) Fée, Genera (1850–'52) 233.
Polypodium parietinum Kl., Linnaea 20 (1847) 373.

"Rhizomate repente, evanescenti-paleaceo; frondibus dense approximatis linearibus, utrinque attenuatis, subcrasso-spongiosis, vix repandis, undique rufescenti-pilosis; stipitibus nullis; venis pinnatis, ramis bi-trifurcatis; soris sparsis, mediocribus, ferrugineis, margine approximatis, uniserialibus.

"Rhizoma repens, semilineam crassum, paleis lanceolatis, sordide fuscis vestitum. Frondes lanceolato-lineares, dein fuscenscentes, 3–5 pollices longae, 3–4 lin. latae.

"Ad saxor. parietes humidas in Colonia Tovar Columbiae. Moritz n. 253."—Klotzsch, l. c.

I have seen no specimen authentically referable to this species. Maxon, with the Kew specimen of *Moritz 253* in hand, writes: "It is somewhat like *P. yarumalense* in general appearance, but differs notably in its large, lustrous, dark brown rhizome scales, and in other characters."

11. **POLYPODIUM YARUMALENSE Hieron.**

Polypodium yarumalense Hieron., Bot. Jahrb. **34** (1904) 499.

"*Eupolypodium;* rhizomatibus brevibus erectis, vix ultra 4 mm longis, 1½–2 mm crassis, dense paleaceis; paleis aureo-ferrugineis, e basi cordata ovatis vel deltoideo-ovatis, acutis, in pilum saepe ramosum desinentibus, margine obsolete denticulatis et pilis ferrugineo-fuscis usque c. 0.15 mm longis vix usque 0.01 mm basi crassis simplicibus vel basi articulatis sparse ornatis; paleis maximis c. ½ mm longis (pilo terminale excluso), ¼ mm supra basin latis; foliis breviter petiolatis; petiolis vix ultra 6 mm longis, compresso-teretibus, fuscescentibus, pilis usque 1½ mm vel interdum ultra longis vix 0,01 mm crassis repetito articulatis ferrugineo-fuscescentibus subdense ubique ornatis; laminis foliorum simplicibus, subintegris vel margine obsolete repandis, oblongo—vel lineari-spatulatis, obtusis margine crebrius et subtus sparse pilis iis petioli similibus brevioribus (vix ultra 1 mm longis) ornatis, nervo mediano utrinque parum perspicuo et venis absconditis basi et apice laminae simplicibus medio laminae vel supra medium furcatis praeditis, parum pellucidis, crassiusculis, statu sicco subchartaceis, glaucoviridibus; laminis maximis in speciminibus 7½ cm longis, 4–4½ mm infra apicem latis; soris circularibus, 1–1½ mm diametientibus; sporangiis crebris, lateribus hyalinis et annulo aureo-ferrugineo praeditis; pilis paucis iis laminae marginis similibus saepe sporangiis intermixtis.

"Species *P. Sprucei Hook.* et *P. parietino* Klotzsch valde affinis; praesertim prioris varietati *furcativenosae*, a qua differt rhizomatibus paleaceis (in illa pilosa sunt), nervo mediano venisque lateralibus extrinsecus minus perspicuis, venarum furcatarum ramis angulo majore divergentibus, laminis foliorum parum latioribus, soris a nervo mediano magis remotis etc. A forma typica *P. Sprucei* Hook. praeterea differt venis lateralibus saepe furcatis. A *P. parietino* Klotzsch differt rhizomatibus breviter erectis (in illa repentis), paleis longis ornatis, laminis foliorum minoribus et pro conditione angustioribus, soris margini nervoque mediano magis approximatis etc.

"Columbia: habitat ad arborum truncos in silvis densis prope Yarumal in montibus septentrionalibus antioquiensibus, alt. s. m. 2000–2200 m (Lehmann n. 7390; m. Nov. 1891."—Hieron., l. c.

Besides the specimen of the type collection, and the Panama specimen, *Mrs. Cornman 1202,* cited by Maxon, he sends me *Maxon 2736* from Jamaica, and *Ekman H. 12810a,* from Haiti, both conforming perfectly to the type collection. The paleae are very inconspicuous, but with sufficient care minute, hairy, brown scales can be detected.

FIG. 9

Both Hieronymus and Maxon have been at some pains to distinguish this from *P. Sprucei,*

but it is not easy to be sure from apparently juvenile plants (*P. Sprucei,* as known) what the fully developed form might be. Hieronymus also, as quoted above, distinguishes it from *G. parietina* by several criteria, which may be convincing if one has authentic specimens to compare, but are not so by description alone. As to color of paleae and position of sori, the specimen in hand of the type collection of *P. yarumalense* is better described by Klotzsch (as *P. parietinum*) than by Hieronymus. I suspect strongly that the two are one species.

12. POLYPODIUM SPRUCEI Hooker

Polypodium Sprucei Hooker, 2nd. Cent. (1861) *pl. 10.*

"Nanum, caudice brevi subfiliformi repente, stipitibus dense caespitosis vix bilinearibus, frondibus membranaceis subunciam longis oblongo-subspathulatis obtusis indivisis integerrimis utrinque marginibus stipitibusque villis longis ferrugineis basi latioribus scariosis pilosis, costa gracili flexuosa, venis obliquis remotis simplicibus apice clavatis intra marginem terminantibus, soris paucis in apicem venarum superiorum globosis.

"Hab. Near Tarapota, Eastern Peru, *Spruce n.* 4746.

"I do not find, anywhere described . ."—Hooker, l.c.

Known by the type collection, of which a fragment is in the U. S. Nat. Herbarium. It is a dwarf, stipe 5 mm and lamina 15 mm long. Except that some minute paleae can be detected, it would be referred without hesitation to *G. jungermannioides.* In spite of this apparent difference, I suspect that it represents that species.

13. GRAMMITIS TRIFURCATA (L.) Copel.

Grammitis trifurcata (L.) Copel., Genera (1947) 211.

Polypodium trifurcatum L., Sp. Pl. (1753) 1084; Maxon, Pterid. Porto Rico 410.

P. comptoniaefolium Desv., Berlin Mag. 5 (1811) 316; Hooker, Sp. Fil. IV 194.

P. comptonioides Desv., Mèm. Soc. Linn. 6 (1827) 231.

P. scolopendrioides H. and G., Ic. Fil. 1 (1828) *pl. 42, non* L.

"Polypodium frondibus lanceolatis glabris repando-sinuatis; apice trilobis.

"Lingva Cervina sinuosa in summitate trisulca. Plum. fil. 115. t. 131.

"Phyllitis folio, longo apice palmato. Plum. fil. 6. t. 6.

"Habitat in America meridionali."—Linnaeus, l. c.

"Rhizome short-creeping, 2–4 cm. long, 4–6 mm. thick, the exposed apex densely paleaceous; scales tufted, golden brown, lance-attenuate or broader, about 5 mm long, lax, reticulate, denticulate-ciliolate. Fronds ascending, 15–35 cm. long, decurved at the base of the blade, the stipe 5–10 cm. long, slender, castaneous, lustrous, castaneous-pilose; blades linear-lanceolate to ligulate, 10–25 cm. long, 1.5–4 cm. broad, short-cuneate at base, subentire at the acute or acutish apex, elsewhere obliquely lobed one-third or half-way to the slender concealed costa, the lobes semicircular

to deltoid and acutish, 6–12 mm. broad at the acutish sinuses, entire, bearing a few marginal setae; veins very oblique, flexuose, pinnately branched within the lobes, the basal branches variously joined or not; sori elliptical, superficial, terminal or subterminal on short distal secondary branches, distant, arranged in a single row at either side of the main veins. Leaf-tissue bright green, loosely spongiose, the sori depressed in drying."—Maxon, l. c.

This is the first described and commonest species of a group characterized by ciliate and usually pale paleae and hairy fronds of spongy texture. The monstrous specimen responsible for the name was from Martinique. Specimens are in hand from Guadeloupe, *L'Herminier, Duss 4080;* Porto Rico, *Sintenis 1336, Wilson 143, Hess 316;* Haiti, *Abbott 2082, Ekman 11523, 16312;* Jamaica, *Maxon 944, 9200, 9550, Sherring;* Bolivia, *Buchtien 5245;* Peru, *Killip* and *Smith 25803;* Ecuador, *Rimbach 27;* Colombia, *Lehmann 932, 7664* (var. *brevipes* Hieronymus), *Daniel 1209;* Panama, *Pittier 5636, Killip 5284, Lankester 815a, Valerio 135, Skutch 3638;* Guatemala, *Cook* and *Griggs 384.*

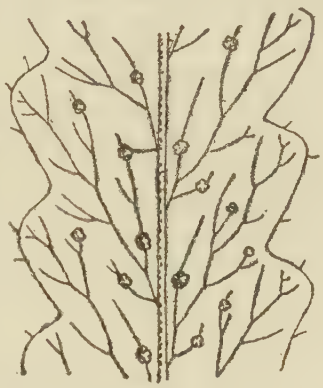

FIG. 10

14. POLYPODIUM TRICHOSORUM Hooker

Polypodium trichosorum Hooker, 2nd. Cent. (1860) *pl. 12.*

"Caudice subrepente crassiusculo fulvo-crinito, stipitibus caespitosis 2–3 uncialibus gracilibus filiformibus, frondibus indivisis 4–5-uncialibus subspathulato-lanceolatis membranaceis translucidis flavo-viridibus obtusiusculis integerrimis vel crenato-lobulatis (lobis obtusis) supra parce subtus marginibus stipiteque pilis ferrugineis patentibus longis copiose crinitis, venis patentibus flexuosis subdichotome pinnatis, venulis apice clavatis, soris sub-4-serialibus parvis in apicem venularum, pilis plurimis inter capsulas.

"Hab. On Trees, forest of Archedona, Quitinian Andes, *Prof. W. Jameson, n.* 349."—Hooker, l. c.

I have seen no specimen, and the species seems never again to have been collected. Hooker's figures show the sori to be superficial, and the lamina to be thick.

15. GRAMMITIS NESIOTICA (Maxon) Copel., comb. nov.

Polypodium nesioticum Maxon, Smiths. Misc. Coll. 47 (1905) 410, *Pl. 57.*

"Rhizome suberect, about 1 cm. long, densely clothed with closely appressed imbricate lanceolate dull light-brown scales; fronds few, approximate, 15 to 22 cm. long; stipe relatively very short (1 to 2 cm. long), densely beset with slender spreading rigid reddish hairs; lamina (largest) 20.5 cm. long, 0.9 cm. broad, bright green, firm, moderately thick, linear-lingulate, rather blunt at the apex, attenuate and decurrent at the base, the under surface sparcely hairy, the upper surface glabrate, the margins regularly marked by broad shallow undulations, ciliate; midvein apparent on the under surface nearly throughout, on the upper surface concealed by the parenchyma except towards the base; venation free, the oblique veins for the most part alternately 3 to 5 times forked; sori round, either terminal or dorsal, wholly superficial, 2 to 4 to each group of veins, irregularly disposed in two or four interrupted rows.

"*Jamaica.*—Founded upon a single specimen, U. S. National Herbarium, no. 520770, from the vicinity of Vinegar Hill, altitude 1,200 meters; William R. Maxon, no. 2773; June 23, 1904."—Maxon, l. c.

This is still known by the one type plant only. It looks like a distinct species. The very pale young paleae are short-ciliate. Cells of the annulus, 12 or 13.

16. GRAMMITIS MINUSCULA (Maxon) Copel., comb. nov. **Plate 3.**

Polypodium minusculum Maxon, Cont. Nat. Herb. **13 (1909) 11.**

"A small epiphytic plant with about 6 entire rigid stipitate deflexed spongiose-coriaceous fronds, 6 to 9.5 cm. long; rhizome erect, 1 cm. or less high, about 3 mm. in diameter, the crown clothed with numerous lanceolate yellowish brown scales 2 to 2.5 cm. long; stipe dull brownish, slender, wiry, less than 0.5 mm. in diameter, 2 to 3.5 cm. long, arcuate, thickly clothed with erect spreading reddish castaneous hairs about 1 to 1.5 mm. long; lamina light or yellowish green, 4 to 6 cm. long, about 0.8 to 1 cm. broad, oblanceolate, tapering in both directions, the apex obtuse or subacute, the base acutely cuneate, both surfaces and the margins ciliate, the hairs like those of the stipe but frequently longer, those of the surface sometimes attaining a length of 2 mm. margins entire or rarely somewhat sinuate; midvein concealed, flexuose; veins 15 to 20 pairs, 4 or 5 times forked, wholly concealed in the spongiose tissue, but easily apparent by transmitted light, the tissue then very translucent; sori superficial, orbicular or broadly oval, 1 to nearly 1.5 mm broad at maturity, borne usually at or near the end of both the superior and inferior basal branches (occasionally also upon the outer branches), thus disposed in two irregular lines, one on each side of the midvein and mostly nearer to this than to the margin.

". . . Coban, Alta Verapaz, Guatemala . . . alt. 1,600 m . . ., von Türckheim, No. II. 1987, November, 1907 . . .

"*P. minusculum* is a diminutive member of the group of *P. trifurcatum* and finds its nearest ally in the Jamaican *P. nesioticum.* From this it differs in its smaller stature, short oblanceolate laminae, more general hairy covering, nearly or quite entire margins, concealed midvein . . ."—Maxon, l. c.

Although still known by a single collection (of a considerable number of uniform plants), this is a well defined species, and well described. The statement as to the size of paleae is an obvious misprint; the length is 2.5 mm. They darken, those at the tip of the rhizome being yellowish, the older ones brown. They bear a few minute, pale marginal hairs, like those abundant on *G. trifurcata.*

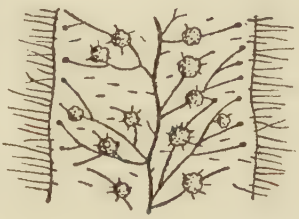

FIG. 11

17. POLYPODIUM INSIDIOSUM Slosson

Polypodium insidiosum Slosson, Bull. Torrey Bot. Club. **39** (1912) 287, *pl. 23, fig. 4–8.*

"Rhizome erect or oblique, about 1.5 cm. or less long, about 3 mm. or more in diameter, the crown thickly clothed with yellowish brown lanceolate or oblong-lanceolate scales 1 to 3 mm. long, having minute, rarely jointed, processes on their margins; stipe dull brownish or blackish, slender, wiry, terete, often arcuate, at least when dried, 0.5 to 3.5 cm. long, glandular-pubescent, clothed at the base with a few scales similar to those of the rhizome; lamina 3 to 10 cm. long, 6 to 13 mm. broad, lanceolate and broadest at or below the middle, or linear, rarely oblanceolate, acute or obtuse, at base acutely cuneate and very shortly decurrent, entire, repand, or somewhat sinuate, glandular-pubescent, glabrescent; the margin and lower surface, especially about the sporangia, sparingly furnished with short brown spreading hairs, a few sometimes on the upper surface also; midvein flexuose, mostly concealed, or slightly evident below and then blackish; texture chartaceous-coriaceous; veins usually apparent by transmitted light; the primary veins mostly with from 2 to 4 pairs of simple or occasionally once forked, free or casually uniting branches; sori apical or dorsal on the innermost branches or on short spurs of these, irregularly 1– to 3-serial, orbicular or oval, 1 to 2 mm. broad, superficial; sporangia glabrous; spores finely papillose."—Slossen, l. c.

CUBA: Oriente, near Camp La Gloria, alt. 762 meters, on mossy trunks, *J. A. Shafer 8043.*

"This plant strongly suggests a small mock *Polypodium trifurcatum.*"

This species is still known by the original collection only. The specimen in the U. S. Nat. Herb. shows no paleae on the stipes. This species is identical in most respects with *G. minuscula,* and, so long as both are known by single collections, the apparent differences in form may not be accepted with confidence. The type collections do, however, differ conspicuously in hairiness; fronds of *P. insidiosum* with sporangia

not yet fully mature have the stipe and margin very sparsely setulose.

The group of *G. trifurcata* is one of the most distinct ones in its genus, uniformly characterized by paleae with marginal outgrowths, hairiness, thick and spongy lamina, and freely branched veins. This free branching of the veins is correlated with instability of margin, a tendency to anastomosis, and pluriseriate sori. The group consists of one species ranging from Bolivia to Guatemala and Porto Rico, and a number of rare and local forms described as species. Because it was first described and is well known, *G. trifurcata* typifies the group; but, within the genus, it is the end of its series, all other described species being more conformable to the generic type. It must be observed that each of these four is known by a single collection, and that only *G. minuscula* is known by a considerable number of approximately uniform individuals. With this exception, it may be considered possible that they are atavistic, abnormal individuals; also, that if they are recollected, their distinctive features may be found inconstant. I have presented them in the sequence of their publication.

Two other Costa Rican species assigned by their author to this group are *Polypodium rosulatum* Christ, Bull. Boiss. **4** (1896) 662, and *P. repletum* Christ, Bull. Boiss. **II 7** (1907) 260. Each is known by a single collection. I do not venture to appraise them by the descriptions.

In this group are also some local species which it seems more convenient to remove generically from *Grammitis* because of normal and more or less regular anastomosis of the veins; that is, they differ from *Grammitis,* as a matter of verbal definition, in the same way as the presumably derived Oriental genus *Loxogramme.* The oldest distinctive generic name for one of these is:

Glyphotaenium J. Smith, Hist. Fil. (1875) 187, typified by *G. crispatum* J. Smith, *ibidem.*

Ctenopteris crispata J. Smith, Seemann, Bot. Voy. Herald (1854) 227, *pl. 48.*

This is a species of southern Panama and Colombia, in the middle of the area of *G. trifurcata.* Except where the frond narrows to apex and base, the veinlets anastomose quite regularly to form narrow costal areolae, like those of *Pleocnemia;* toward the margin, more casual anastomoses are fairly common. The sori are immersed, and oblong or sometimes round. The affinity to *G. trifurcata* is perfectly clear, attested by the

crenate, hairy, spongy frond, and by sparse, pale marginal hairs on the yellowish-brown paleae. Treated as *Polypodium,* this has had to be renamed, *P. goniopteroides* C. Chr., Index 188, 530. The name *crispatum* is questionably valid in any genus; it was applied because of avowedly doubtful identification with *P. crispatum* L.

Polypodium ecostatum Sodiro, Crypt. Vasc. Quit. (1893) 308, is evidently a *Glyphotaenium:* "Soris immersis . . .Venas . . . el ramo proximo al nervio medio anastomosado, por lo común, con éste formando aréolas costulares." The description applies well to *G. crispatum,* which seems then to range South into Ecuador.

Polypodium Harrisii Jenman is a similar or identical species of Jamaica and Hispaniola. Besides a type fragment the U. S. Nat. Herb. contains *Maxon 2287* and *Maxon* and *Killip 789* from Jamaica; *Abbott 442* and *Ekman H. 14259* from Santo Domingo.

Glyphotaenium percrassum (Baker) Copel., Genera (1947) 212.

Polypodium percrassum Baker, Journal of Bot. **25** (1887) 26.

Distinguished by smaller and still thicker fronds. Apparently common in Costa Rica. *P. enterosoroides* Christ, also of Costa Rica, is doubtfully distinct.

Enterosora Baker, Timehri V (1886) 218; Trans. Linn. Soc. Bot. **II** 2 (1886) 294, *pl. 58.*

Distinguished from *Glyphotaenium* by having more completely immersed sori,—borne in cavities in the spongy frond, which open by superficial slits. Baker figured the paleae of *Glyphotaenium Campbellii,* the type species of *Enterosora,* as entire. *E. Fawcettii* Jenman, reduced by Christensen to *E. Campbellii,* has marginal outgrowths longer and more slender than those of *Glyphotaenium* and the related species of *Grammitis,* and occasionally present on the surface of the paleae. The paleae of *G. spongiosum* (Maxon) Copel. (*Enterosora spongiosa* Maxon, Proc. Biol. Soc. Wash. **52** (1939) 113, Plate 4, are similar. The last is a distinct species, the well developed fronds lobed, much as those of *G. trifurcata.*

In my opinion, one genus derived from the group of *G. trifurcata,* characterized by anastomosing veins and immersed sori, may well be distinguished, but more than one is superfluous. *Glyphotaenium* is the older and tenable name, and *Enterosora* should be included in that genus. Baker simply ignored Smith's genus, as Smith's British contemporaries too commonly treated his work.

COMMENT ON AMERICAN GRAMMITIS

While the presentation of the species with dark borders is deferred, this is the appropriate place for comment on the American species as a group. As compared with *Grammitis* in the Orient, its characteristic here is its diversity. There is no subgeneric group rich in number of species, but the groups themselves are more distinct here than elsewhere. Also, several of them are quite definite points from which evolution has produced what are, more or less conveniently, regarded as daughter genera. Species which constitute or represent such groups are:

1. *G. marginella,* with dark border; discussion deferred.

2. *G. graminea,* with marginal anastomoses. *G. turquina* is the only other such species. Both are local, on single West Indian islands. There is no derived group.

3. *G. wittigiana,* with unstable margin, especially in the lower, sterile part of the frond. This represents a practical origin of Kaulfuss' genus *Xiphopteris.* My disposition to maintain *Xiphopteris* involves no lack of appreciation of Maxon's demonstration, Cont. U. S. Nat. Herb. **17** (1914) 398, that the known series of forms connecting *X. serrulata* and species with regularly pinnatifid fronds is very complete; I include the latter in *Xiphopteris.* Maxon has not questioned the specific status of his *Polypodium duale* (*X. serrulata*) ; and I may here shock some of my colleagues with the proposition that any distinction of specific value may as well have generic value if convenience justifies giving it that status. The fact is that the apparent affinity of *X. serrulata* to *G. wittigiania* in one direction, and to regularly pinnatifid species in another can be explained in more than one way, or may be only apparent, not real.

4. *G. furcata,* with simple veins. There is no question about the close affinity of this species and *G. Tatei,* with forked fertile veins. Some reduction of the fertile veinlet is common in the genus, occurring in all geographic regions except the subantarctic. From this group originates Kaulfuss' genus *Cochlidium,* which, if maintained, must be recognized as so treated for the sake of convenience. The perfectly parallel oriental genus *Scleroglossum* seems for the present to be more "respectable," because the series of intermediates going to *Grammitis* is less completely known.

5. *G. trifurcata,* which has already been discussed sufficiently.

6. *G. jungermannioides,* characterized by suppression of the paleae. This is a negative peculiarity, consequent on the short-

ening of the rhizome and the congestion of the stipes. The same phenomenon in other lands has been noted in my introductory remarks.

THE MADAGASCAR—AFRICAN SPECIES

Key to the species

Without dark margins.
  Veins forked.
    Sori strictly uniseriate.
      Hairs minute, deciduous ..... 18. *G. cryptophlebia*
      Hairs long (2 mm) ..... 19. *G. Poolii*
    Sori biseriate in full development ..... 20. *G. barbatula*
    Sori pluriseriate ..... 21. *G. uluguruensis*
  Veins simple.
    Stipe and margin hairy.
      Fronds 5 cm long or longer.
        Sori inframedial ..... 22. *G. holophlebia*
        Sori medial ..... 23. *P. tanalense*
      Fronds up to 4 cm long.
        Rhizome short, fronds fascicled..... 24. *P. Gilpinae*
        Rhizome elongate ..... 25. *G. synsora*
    Stipe and lamina glabrous.
      Rhizome elongate
        Paleae obtuse ..... 26. *G. pellucidovenosa*
        Paleae acuminate ..... 27. *P. Pervillei*
      Rhizome short, fronds fascicled ..... 28. *G. pygmaea*
Lamina dark-marginate,—see page 253.

18. GRAMMITIS CRYPTOPHLEBIA (Baker) Copel., comb. nov.

Polypodium cryptophlebium Baker, Jour. Bot. **18** (1880) 370.
P. Rutenbergii Luerss., Abh. bot. Verein Bremen **7** (1882) 48, *pl. 1, fig. 1, 2;* Christensen, Dansk bot. Arkiv **7** (1932) 150, *pl. 56, fig. 21, 22.*

"Rhizome slender, short-creeping; paleae minute, brown, adpressed, lanceolate. Stipe scarcely any. Lamina entire, linear, very rigid and coriaceous in texture, minutely pilose, obtuse, narrowed very gradually to the base, 1½–2 in. long, ⅛–¼ in. broad. Veins quite hidden, arcuate-ascending, forked. Sori oblong, superficial, filling up the whole spaee between the midrib and margin of the frond except in the narrowed basal portion, the oblong oblique receptacles nearer the midrib than the edge. Between Tamatave and Antananarivo."—Baker, l. c.

Palm and *Afzelius s. n.*, in U. S. Nat. Herb., represents this species and appears to be typical. Paleae 1 to 1.5 mm long, narrow, castaneous; hairs on lamina mostly marginal, very minute, moderately persistant; cells of the annulus about 10.

Polypodium Molleri Baker, Bol. Soc. Brot. **4** (1886) 154, *pl. 2, fig. B,* of Pico de S. Thomé, alt. 1,900 m, off the west coast of Africa. An imperfect isotype is in Herb. Univ. Calif. It is *Grammitis cryptophlebia* or very near to that species.

19. **GRAMMITIS POOLII (Baker) Copel.**

Grammitis Poolii (Baker) Copel., Genera Filicum (1927) 211.
Polypodium Poolii Baker, Jour. Linn. Soc. **15** (1886) 419; Christensen, Dansk bot. Arkiv **7** (1932) 151, *pl. 56, fig. 7–10.*
P. microphyllum Baker, Kew Bull. (1897) 299.
P. pseudo-poolii Reimers, Notizbl. Berlin **11** (1933) 934.

"Stipes tufted, ¼–½ inch long, densely clothed with spreading red-brown bristly hairs a line long. Frond simple, ligulate, 1½–2 inches long, ⅛ inch broad, narrowed gradually from the middle to a cuneate base, entire. Texture membranous. Both sides green, profusely clothed with fine red-brown spreading hairs like those of the stipe. Midrib flexuose; veins distant, immersed, arcuate-ascending, forked near the base, not reaching the edge. Sori round, superficial, ¾–1 line broad, terminal on the anterior fork of the veins, forming a row on each side of the midrib, medial between costa and margin.

"Near *P. Sprucei* and *Hookeri.*"—Baker (1886).

The U. S. Nat. Herb. contains fronds of *Perrier de la Bathie 7478,* which Christensen figures and calls the typical form. *Forsyth-Major 477,* type collection of *P. microphyllum,* is well represented in Herb. Univ. Calif.

Rhizome short, densely beset with very hairy stipes. Baker does not mention paleae (except as he calls them hairs). Reimers says of his *P. pseudo-poolii* "Squamulae rhizomatis non visae." Christensen says "scales small, castaneous, lanceolate, entire." With ample material and careful dissection, I find them on *Forsyth-Major 477.*—vestigial structures about 0.3 mm long. It would be easier to overlook them and conclude that they are completely suppressed, as seems to happen among the dense and densely hairy stipes of *G. jungermannioides* and some specimens of *G. Havilandii.* Christensen reports variation from 1 to 7 cm in length of frond. The hairs are peculiar, composed of many (even 10 or more) cells, and sometimes swollen at the septa. Christensen notes that the sori are especially hairy, but I have been unable to be sure that any bristle is borne on a sporangium. Annulus, 13 or 14 cells.

FIG. 12

P. pseudo-poolii, from the Uluguru mountains, is compared with *G. Poolii:* "Die einzige Unterschied besteht darin, dass bei *P. pseudo-Poolii* eine sehr auffallende Randgliederung der Blätter neben der für *P. Poolii* charakteristischen auftritt . . . Ob dieser abweichende Laminazuschnitt nur eine zufällige Mutation von *P. Poolii* darstellt, oder als Artmerkmal zu bewerten ist, muss weiteres Material zeigen." As such freaks

are now familiar in a considerable number of species, it seems only reasonable to regard this as another of the same kind.

20. GRAMMITIS BARBATULA (Baker) Copel., comb. nov.

Polypodium barbatulum Baker, Syn. Fil. (1867) 323; Christensen, Dansk bot. Arkiv 7 (1932) 152, *pl. 57, fig. 20–22.*

"Stipes tufted, slender, ¼–½ in l., ¼ in. br., the edge entire or broadly lobed to a depth of ½ line; texture subcoriaceous; both sides more or less densely clothed with long soft hairs; veins pinnate in the lobes; sori medial, uniserial.—P. ciliatum Bojer, Hort. Maur. p. 416. (non Willd.).

"Hab. Bourbon."—Baker, l c.

"*P. barbatulum* (Madagascar, Mascarenen) kommt dem *P. uluguruense* am nächsten, ist aber kleiner (Blätter ca. 6 cm lang) und zeigt meist nur eine inframediale Sorusreihe jederseits, nur an grösseren Blättern öfter 2 sori auf jedem Laminalappen, während an normal ausgebildeten Pflanzen von *P. uluguruense* 4 sori auf jedem Lappen die Regel ist. Ausserdem sind bei *P. barbatum* die Blätter weniger tief eingeschnitten."—Reimers, Notizbl. Berlin **11** (1933) 934.

"Closely related to *P. Poolii:* differs from it by its longer, slender stipe, thinner texture and inframedial sori; the whole leaf is clothed with very long reddish hairs, the lamina sinuate repand to deeply lobed or pinnatifid."—C. Chr., l. c.

I have not seen this species, but venture to transfer the name because it has priority over the related species.

21. GRAMMITIS ULUGURUENSIS (Reimers) Copel., comb. nov.

Polypodium uluguruense Reimers, Notizbl. Berlin **11** (1933) 952.

"Rhizoma breviter repens vel ascendens, apice solum foliis haud dense, squamulis densissime obtectum. Squamulae atro-fuscae, subulato-lanceolatae, cuspidatae, ca. 3,5 mm longae, 0.2 mm latae, marginibus minutissime fimbriatis. Folia petiolata, 10–40 cm longa. Petioli 4–8 cm longi, ca. 0.8 mm crassi, rufescentes, teretes; pilis strictis, ad 1,2 mm longis, tenuissimis, rufescentibus, recte patentibus densissime obtecti. Lamina e basi breviter cuneata lineari-lanceolata, 0,7–1,8 cm lata, plerumque usque ad partem superiorem ⅛–1/10 aequilata, apicem versus sensim attenuata, apice ipso obtuse acuta; marginibus praecipue basin versus usque ad ⅓ semifaciei regulariter repando-sinuata, lobis perobtusis perlatis porrectis; rarius (fere solum in foliis primariis) integra. Lamina olivaceo-rufescens vel atro-rufa, subtus pallidior; chartacea, plana, longitudinaliter rugosa; marginibus densissime, subtus et supra sat dense pilosa. Nervus medianus flexuosus utraque facie prominulus. Nervi laterales mesophyllo induti, solum in foliis primariis conspicui, angulo ca. 45° patentes, remoti; bis, ter vel quater furcati; apicem folii versus interdum anastomosantibus, marginem non attingentes. Sori sordide brunnei, non immersi; in foliis angustioribus in una serie inframediale dispositi et ramo antico impositi; plerumque demum 2–4 in utrique lobo et ramis anticis et posticis impositi. Sporae subglobosi, 25–30μ diam., pallide olivaceae, minute verrucosae.

"Uluguru-Gebirge: NW., Parata-Pass, ca. 1910 m, Nebelwald, an Bäumen vereinzelt (18. Okt. 1932)—H. J. Schlieben n. 2827).

"Die neue Art ist am nächsten mit P. Harrisii Jenm. aus Jamaica und Dominica verwandt."—Reimers, l. c.

Any affinity of a plant with superficial sori to *Polypodium Harrisii,* which is a *Glyphotaenium,* is more than doubtful. It is more probable, and would seem to be a safe assumption, that this is a near relative of *G. Poolii,* and that *G. barbatula* occupies the gap between them. However, I have not seen it.

22. GRAMMITIS HOLOPHLEBIA (Baker) Copel., comb. nov.

Polypodium holophlebium Baker, Jour. Bot. 18 (1880) 370; Christensen, Dansk bot. Arkiv 7 (1932) 151, *pl. 56, fig. 17, 18.*

"Rhizome slender, short-creeping; paleae minute, lanceolate, dull brown. Stipe under an inch long, dull brown, finely pilose. Lamina entire, linear, moderately firm in texture, green on both sides, obscurely pilose, principally on the edge and midrib beneath, 3–4 in. long, ⅛–¼ in. broad, obtuse, narrowed gradually at the base. Veins close, regular, simple, distinct, erecto-patent, ending in a dot a short distance from the margin. Sori round or round-oblong, superficial, forming a couple of long rows close to the midrib, dorsal as regards the veins. Tanala. General habit, texture, and veining very like those of *P. marginellum.*"—Baker, l. c.

Paleae fuscous, 1 mm or slightly more in length, up to 0.4 mm broad at the base, closely appressed. Hairs very slender, and so pale as to be inconspicuous, although numerous. Lamina cuneate at base, fairly coriaceous, with a narrow, light cartilaginous margin. Sori inframedial, rather than costal; receptacle, and most sori, distinctly elongate.

Polypodium tanalense Baker, from the same type locality, was to be distinguished by firmer texture, and more distal and longer sori. *Humbert 6329,* in the U. S. Nat. Herb., fits one description about as well as the other. It is the subject of the preceding notes. The two seem to be hardly distinct; but, as the material hardly justifies reduction, I let the description of *P. tanalense* follow.

23. POLYPODIUM TANALENSE Baker

Polypodium tanalense Baker, Kew Bull. (1897) 300; C. Chr., Dansk bot. Arkiv 7 (1932) 151, *pl. 56, fig. 15–16.*

"A *P. marginello* Sw., frondibus haud nigro-marginatis recedit.

"Rhizoma breviter repens. Stipites erecti, 9–12 lin. longi, pilis paucis patulis brunneis vestiti. Frondes simplices, lineares, integrae, 4–5 poll. longae, 3–4 lin. latae, rigide coriaceae, utrinque glabrae, margine pilis paucis brunneis praeditae; venae simplices, laxae, erecto-patentes, paral lelae, perspicuae, ad marginem haud productae. Sori uniseriati, oblongi, ad venas terminales, inter costam et marginem mediales.

"Madagascar, Forest of Ambohimitombo, Province of Tanala, *Forsyth Major,* 185."—Baker, l. c.

24. POLYPODIUM GILPINAE Baker

Polypodium Gilpinae Baker, Jour. Linn. Soc. **16** (1877) 20; C. Chr., Dansk bot. Arkiv **7** (1932) 151, *pl. 56, fig. 13, 14.*

"Densely tufted. Stipes very short (¼–½ in. long), clothed with fine brown spreading hairs. Fronds simple, ligulate, obtuse, 1–1½ in. long, ⅛ in. broad, entire or obscurely repand, moderately firm in texture, narrowed from the middle to the base, thinly beset with erect-patent brown hairs ½ line long. Veins distant, simple, erecto-patent, thickened at the tip, and not reaching the edge. Sori round, superficial, ½ line broad, median between the edge and the midrib, 8–12 on a side, with usually their own breadth between them."—Baker, l. c.

Madagascar, collected by Miss Gilpin.

"A very problematic species, probably a small form of *P. Poolii* and about the same as *P. microphyllum* Bak."—Christensen, l. c. I have not seen this, and would observe that the fertile veins of *P. microphyllum* are forked, even on fronds less than 2 cm long. Also, as a name, *P. Gilpinae* antedates *P. Poolii.*

25. GRAMMITIS SYNSORA (Baker) Copel., comb. nov.

Polypodium synsorum Baker, Jour. Linn. Soc. **16** (1877) 203; C. Chr., Dansk bot. Arkiv **7** (1932) 150, *pl. 56, fig. 11–12.*

"Rhizome threadlike, wide-creeping. Stipes ¼–½ in. long, clothed with fine brown spreading hairs. Frond simple, coriaceous, ligulate, obtuse, cuneate at the base, 1–1¼ in. long, 2–2½ lines broad, glabrous, veins simple, erecto-patent, hidden. Sori round, superficial, forming a row close to the midrib in the upper half of the frond, confluent, mixed with copious hairs."—Baker, l. c.

Madagascar, collected by Miss Gilpin.

Represented in U. S. Nat. Herb. by *Humbert 3611.* Paleae about 1 mm long, lanceolate, acute, entire, fuscous. The pale hairs in the sori are paraphyses, sometimes branched, not borne on the sporangia. Cells of the annulus about 13.

26. GRAMMITIS PELLUCIDIVENOSA (Bonap.) Copel., comb. nov.

Polypodium pellucidivenosum Bonap., Notes Pterid. **10** (1920) 189.

"Rhizome longuement rampant, flexueux, couvert de petites écailles lancéolée, arrondies au sommet, concoloros, brunes.

"Frondes éparses, à environ 0^m,005 les unes des autres. Jusqu'à 0^m,06 de long sur 0^m,003 de large. Linéaires dans toute leur longueur, sauf à la base, oú elles s'atténuent jusqu'au rhizóme sans laisser de pétiole distinct; dans cette région, le rachis est bordé de chaque côté d'une aile très étroite; arrondies au sommet. Consistance herbacée; glabres. Rachis saillant à la face inférieure, beaucoup moins à la face supérieure où il est cependant fort visible; penné. Nervures secondaires libres, alternes, simples, ne s'étendant pas jusqu'au bord des frondes; épaisses au sommet, translucides.

"Sores d'abord allongés, type grammitis, puis courts. Une rangée de chaque côté du costa dans la partie supérieure des frondes. A la maturité, ces sores se touchent et occupent tout l'espace compris entre le costa et les bords des frondes. Les points d'insertion de ces sores sont marqués à la face supérieure des frondes par un point noir ou brun.

(Madagascar) "Région floristique du Centre. Massif de Manongarivo . . . 1200 m. . . . (Perrier) 7421 . . . 7704."—Bonaparte, l. c.

Scales of the long-creeping rhizome yellowish-brown, ovate, obtuse, leaf entirely glabrous, veins short, simple, indistinct, sori close to the midrib, round; paraphyses none."—C. Chr., Pterid. Madag. (1932) 150. In this work, Pl. 56, fig. 5–6, the species is well figured. The paleae are a scant millimeter long, a third as broad, pale-brown. The frond, judging by *Perrier 16182* in the U. S. Nat. Herb., is coriaceous rather than herbaceous; veins inconspicuous; sori not crowded.

27. **POLYPODIUM PERVILLEI** Mett.

Polypodium Pervillei Mett.: Kuhn, Fil. Afric. (1868) 150.

"Rhizoma elongatum, tenerum, paleis rigidulis, fuscis, oblongo-lanceolatis squamosum; folia 2–3‴ distantia, 6–8‴″ longa, sub apice 1‴ lata, spathulata, subcoriacea, glaberrima, basi attenuata, subpetiolata, obtusa; nervi immersi, indivisa, superiores soriferi; sori terminales, pauci sub apice laminae; sporangia inermia; paraphyses nullae.

"Ins. Sechellae (Pervillé).

"Rhizomate elongato, glabritie laminae ab P. pygmaeo, quod et nervis indivisis et soris terminalibus congruit, diversissimum."—Mett. msc., l. c.

"It differs from *P. pellucidivenosum* by its obtuse leaves and by its fuscous, lanceolate acuminate rhizome-scales."—C. Chr., Pterid. Madag. (1932) 150.

See further comment under *G. obtusa.*

28. **GRAMMITIS PYGMAEA** (Mett.: Kuhn) Copel., comb. nov.

Polypodium pygmaeum Buchinger: Kuhn, Fil. Afric. (1868) 152.

"Rhizoma abbreviatum, caespitosum; folia densa, membranacea, glabra, 6–8‴ longa, spathulata, obtusa, basi atenuata, subpetiolata, integerrima; costa flexuosa; nervi indivisi, angulo acuto ascendentes, apice leviter incrassato, sorum vix superantes; sori utrinque ad apicem costulae 1–2, elliptici, rotundati, costulae approximati; paraphyses nullae; sporangia inermia.

"Ins. Borboniae."—Mett. msc., l. c.

MAURITIUS: *Vaughan 60* in U. S. Nat. Herb.

The paleae are brown, up to 1 mm long, ovate to lanceolate. Several of the little cuneiform-spathulate fronds are cleft near the apex. The position of the sorus is unstable. It may be terminal on the short vein; or it may be dorsal, the vein extending a little beyond it; or the vein may be bent at the sorus, making the latter apparently lateral; and in one case

I find it actually removed, occupying a very short acroscopic veinlet. The original label of this specimen is "Polypodium Pervillei Mett. ex char." The stipes are clustered, the rhizome not at all elongate.

There remain two or three supposed species of the East African Islands, as to which I must content myself with reporting what has been published.

GRAMMITIS OBTUSA Willd.

Grammitis obtusa Willd., Kaulfuss Enum. (1824) 84.

"Gr. frondibus linearibus obtusis margine stipiteque dentato-setosis, soris oblongis, caudice filiformi.

"Habitat in insula Mauritii.

"Caudex filiformis repens. Gemmulae paleaceae. Frondes pollicares vel sesquipollicares, lineam vix latae obtusae, sub lente parce denticulatae, denticulis pellucidis stellato-setosis. Stipites tenuissimi semipollicares submarginati dentato-setosi. Sori oblongi, costae paralleli. Venae simplices."—Kaulfuss, l. c.

Christensen, Index 332, 528 (refers this with doubt to *Polypodium furcatum* Desv. *non* Swartz. The latter has been best known by another invalid name, *P. multifidum* Bory *non* Jacq. This is represented in several herbaria (I have not seen it), by Bory's specimens only. Kunze, Suppl. to Schkuhr, Fil. I: 90, Pl. 43, has illustrated it by copying Bory's figure and by several of his own. Unless it be *G. obtusa,* which is a guess without much sanction by the descriptions, it has no valid name. A Mauritius specimen in U. S. Nat. Herb., 1. Mrs. Nicholas Pike in 1869, is labeled *P. multifidum,* but is sterile and may or may not be correctly named; it has no forked fronds. My strongest reason for believing in the identity of *P. furcatum* Desv. and *G. obtusa* is an observation of Blume, Enum. 116, distinguishing *G. setosa* from *G. obtusa* by *"frondibus . . .* haud bifidis uti in hac specie."

Returning to *G. obtusa*: the description is hard to understand.—I do not know what may be meant by 'dentate-setose stipes.' Kuhn, Fil. Afric. 110, cites *Pervillé 769* as this species, ascribing it to Nossi Bé. Under *P. Pervillei,* he cites *Pervillé* without number; this seems likely to be another case in which Kuhn published on the authority of Mettenius without properly careful checking. For Christensen, Dansk bot. Arkiv 7 (1932) 150, *Pervillé 769* is *P. Pervillei.*

POLYPODIUM SPATHULATUM Cordemoy

Polypodium spathulatum Cordemoy, Fl. Reunion (1895) 84.

"Frondes tres glabres, en touffes peu fournies, petites, rappelant par ses dimensions celles du P. melanoloma; texture plus coriace, semblable à

celle de l'Antrophyum immersum. Les frondes sont spatulées, longues de 5 cent., larges de 1–2, très obtuses au sommet, atténuées à la base, et se continuent en un pétiole ailé jusqu'a la base et portant de petites écailles souples très fines, d'un jaune brun, volumineux, allongés, elliptiques. Frondes stériles à pétioles grêles, longs de 3–4 cent., à limbe elliptique, long de 1½ cent., large de ½.

"Les frondes, après la dissiccation, ne deviennent pas brunes comme dans l'espèce précédent et la suivante, mais restent vertes.

"Espèce facile à distinguer; ressemble par son port a l'Acrostichum spathulatum.

"Rare.

"Trouvée a Cilaos par Ed. Bédier."—Cordemoy, l. c.

Without any information as to the venation, it is impossible to place this plant; it might even be a *Loxogramme.*

COMMENT ON AFRICAN SPECIES

The species of Africa and its islands,—mostly they are only insular as known,—are a natural group, all plants of small size even for *Grammitis,* with very small paleae, a number of them with simple veins, none with setose sporangia. While I see no sufficient reason for assuming a direct geographic connection, there is some apparent affinity to American species, shown by the group just discussed, and also by that with dark margins. This affinity is distinctly more evident than any to the species of the Malay-Papuan region. What it may suggest is that the colonization of America and Africa was from the same part of Antarctica, where some geographic segregation within the genus occurred before emigration.

Species of the Pacific Islands

Key to the species

Lamina not dark-marginate.
  Sori in one row on each side of costa.
    Sori costal or subcostal.
      Stipe or frond-base pubescent.
        Stipe elongate (1.5 cm or more).
          Sori superficial.
            Laminar surface naked (Rapa)..... 52. *G. Maireaui*
            Surfaces hairy.
              Hairs very long (Lord Howe).... 30. *G. Wattsii*
              Hairs shorter ..... 47. *G. Hookeri*
          Sori impressed (Samoa) ..... 39. *G. insularis*
        Stipe short (1 cm) or none.
          Surfaces hairy.
            Sporangia setulose.
          Laminar hairs over 1 mm long.
              Fertile veinlet mostly elongate 47. *G. Hookeri*
              Fertile veinlet short ..... 32. *G. neocaledonica*

Laminal hairs up to 1 mm long.
Veins concealed ..... 46. *G. raiatensis*
Veins evident (Marquesas).... 51. *G. miltiblepharis*
Pubescence minute (Solomons).. 35. *G. Brassii*
Sporangia naked.
Paleae not ciliate (Fiji)..... 36. *G. hirtelloides*
Paleae ciliate (Lord Howe)..... 31. *G. nudicarpa*
Surfaces naked or glabrescent.
Sporangia naked (Ponape)..... 54. *G. scleroglossoides*
Sporangia setulose.
Paleae pale (Samoa)..... 37. *G. conformis*
Paleae fuscous (Samoa)..... 38. *G. Christophersenii*
Stipe or frond-base naked.
Lamina herbaceous (Society Ids.) 44. *G. trachycarpa*
Lamina subcoriaceous (Samoa) ..... 41. *G. ligulata*
Lamina rigidly coriaceous (Lord Howe) 29. *G. diminuta*
Sori medial.
Stipe apparently naked (Hawaii)..... 50. *G. tenella*
Stipe or decurrent base pubescent.
Lamina hirsute (Lord Howe) ..... 31. *G. nudicarpa*
Lamina minutely velvety (N. Caledonia) ..... 34. *G. pseudaustralis*
Glabrescent, sparsely ciliate (Tahiti).. 45. *G. subspathulata*
Sori extra-medial.
Sori on both veinlets (New Caledonia).... 33. *G. Deplanchei*
Sori on acroscopic veinlet only.
Stipe hairy (Samoa) ..... 40. *G. Whitmeei*
Stipe obsolete, surfaces naked.
Margin sparsely setulose (Hawaii) 48. *G. Baldwinii*
Margin naked (Hawaii)..... 49. *G. oahuensis*
Sori pluriseriate or scattered.
Costal row of sori well developed (Tahiti) 43. *G. tahitensis*
Costal row irregularly developed (Ponape) 53. *G. ponapensis*
Sori medial or extramedial (Samoa) ..... 42. *G. samoensis*

Lamina with dark margin, . . see page 253

29. GRAMMITIS DIMINUTA (Baker) Copel., comb. nov.

Polypodium diminutum Baker, Syn. Fil. (1874) 507.
P. howeanum W. W. Watts, Jour. Royal Soc. N. S. W. 49 (1915) 388.

"Rhizome short-creeping; scales dense, firm, lanceolate, dark-brown; fr. subsessile, narrow, ligulate, blunt, 4–6 in. l., 2–4 lin. br. at middle, narrowed thence gradually to the base; texture rigidly coriaceous, thick; surfaces naked, pale-green; midrib below very prominent; veins close, immersed, obscure, simple, produced to the edge, much ascending; sori oblong, oblique, placed close to the midrib in the upper third of the frond, not mixed with paraphyses.

"Hab. Lord Howe's Island. G. Moore."—Baker, l. c.

The descriptions of *P. diminutum* and *P. howeanum* can be harmonized except as to the veins. "Venulis numerosis, dichotomis, utrisque furcis equalibus vel subequalibus, fere ad marginem attingentibus, erecto-patentibus indistinctis; soris in superioribus furcis venularum positis."—Watts, l. c. Watts' description is correct. This throws no real doubt on the identification with *G. diminuta*,—Baker made the same mistake too often.

FIG. 13

The species is distinguished from its relative, *G. Billardieri*, by more coriaceous fronds, perfectly naked stipes, and darker, longer, more attenuate paleae, some of them more than 6 mm long.

LORD HOWE ISLAND: *Oliver*, November, 1913, probably the type of *P. howeanum;* its label reads "*Polypodium howeanum* Watts sp. nov. (? *P. diminutum* Baker)." Also, *Headly* and *Dunn* (1908); *Watts* (coll. and det., August, 1911); all sent from the Nat. Herb. N. S. W., Sydney,—a favor it is a pleasure to acknowledge.

30. GRAMMITIS WATTSII Copel., nom. nov.

Polypodium pulchellum W. W. Watts, Jour. Royal Soc. N. S. W. 49 (1916) 386, *nec aliorum.*

"(*P. Hookeri* Brack. et *P. hirtum* Hook. in Herbariis err.)

"Rhizoma robustiusculum, subrepens vel subadscendens, densissime fibrillosum, saepe cum parvis discis (ostendentibus casorum bases stipitum) multo praeditum, apice dense paleaceum, paleis subintegris, brunneis, a basi lata lineari-lanceolatis, acumine in longam subflexuosam, integram setam, interdam geminam, producto. Stipites dense approximati, subcaespitosi, c. 3–4 cm. longi in attenuatum frondis laminam mergentes. Frons integra 1–2 dm. longa, et cir. 1 cm. lata, basin versus sensim tenuissime angustata, supra oblongo-lanceolata, breviter acuminata, acumine obtusiusculo, utrisque faciebus (et marginibus, stipitibus, et soris) cum levibus, integris, brunneis, longiusculis, subflexuosis pilis praeditis; nervo tenui, fere ad apicem attingenti, venulis erecto-patentibus, plerumque dichotomis, interdum trifurcatis, fuscis fere ad marginem attingentibus; soris sat numerosis, obliquis, in seriebus singulis, subjuxtacostalibus, dispositis, juventate sublinearibus, maturitate ovalibus, prope basin superioris furcae venulae positis. Textura tenui-coriacea.

"On the upper slopes and the summit of Mount Gower; also on Mount Lidgbird. (Lord Howe Island).

"This handsome little fern differs from *P. Hookeri*, (1) in size: it is considerably larger; (2) in venation: in *P. Hookeri* the lower fork of the dichotomous venule is much longer than the short upper one that bears the sorus, while in our species the two forks (sometimes three) are of equal or nearly equal length; (3) in the shape and position of the sori, which, in *P. Hookeri*, are larger, rounder, more closely set in the rows, and closer to the midrib; (4) in the surface hairs, which are

shorter and stiffer in *P. Hookeri;* (5) especially in its basal scales, which are very short and broad, and lighter in colour, in *P. Hookeri;* (6) in texture: The veins in our species are, with a lens and transparent light, more or less visible, while in *P. Hookeri* they are altogether abscured."—Watts, l. c.

Paleae 5 mm long, linear, castaneous, nitid, naked except for the apical setae 1 mm long; stipe up to 5 cm long, densely clothed with dark-chestnut hairs 4 to 5 mm long; fronds about 15 × 1 cm, subcoriaceous, the copious hairs about 4 mm long; fertile veinlets prolonged like the sterile, nearly to the margin; sori subcostal, sporangia apparently naked.

FIG. 14

LORD HOWE ISLAND: isotype, *l. et det. W. W. Watts, ex* Nat. Herb. N. S. W.; *G. King* in Herb. Calif. Academy.

Not very near to *G. Hookeri.* Watts' comparison is presumably with the *"P. Hookeri"* ascribed to Queensland, and unknown to me. It must be observed, though, that the Samoan plant (*Powell* in Gray Herb., *Betche* (?) in Herb. Univ. Calif.) which I leave in *G. Hookeri* bears more resemblance to *G. Wattsii* than do specimens from Hawaii and Fiji.

31. GRAMMITIS NUDICARPA Copel.

Grammitis nudicarpa Copel., U. C. Publ. Bot. **18** (1942) 222.

Rhizomate brevi-repente, paleis 1–1.5 mm longis late lanceolatis castaneis setulis concoloribus paucis ciliatis (nec carent omnino setulis superficies) ad apices setiferis; stipitibus approximatis, 1–1.5 cm longis, 0.3 mm crassis, laminisque ubique setis 1–1.5 mm longis rubro-castaneis vestitis; lamina ca. 5 cm longa, 5 mm lata, oblanceolata, apice late rotundata, deorsum longe attenuata, integra, subcoriacea, opaca; venis furcatis ramis ambobus elongatis; soris inframedialibus, superficialibus, orbicularibus vel paullo elongatis, fuscis, sporangiis nudis.

FIG. 15

LORD HOWE ISLAND: Type in Herb. Lugd. Bat. No. 908, 302 . . . 93, *ex* Phytologic Museum of Victoria. The type sheet bears four plants and many loose fronds, and one frond of *G. Wattsii.*

This is a local relative of *G. Wattsii;* both are, so far as known, endemic on Lord Howe Island, and were first distributed as *Polypodium Hookeri.* From the latter, they are different

enough in various ways, but I have been reluctant to regard the two local species as distinct. *G. nudicarpa* is much smaller as a whole and as to each part; but size in *Grammitis* is very subject to edaphic control, and size of paleae and hairs may be correlated with total size. So also may be shape of frond. I include in *G. Billardieri* forms more reduced than *G. nudicarpa*, and like it in oblanceolate form and rounded apex. I do not see, though, how reduction can account for movement of the sori away from the costa, and they are conspicuously farther from it in *G. nudicarpa* than in *G. Wattsii*. The most critical difference is in the paleae,—alike in color and in setiferous tips, but shorter and relatively broad in *G. nudicarpa*, which may be due to the reduction of the whole plant; but setuliferous on the margin, and even, sparsely, on the surface, in *G. nudicarpa*, where those of *G. Wattsii* are naked.

32. GRAMMITIS NEOCALEDONICA Copel.

Grammitis neocaledonica Copel., U. C. Publ. Bot. **18** (1942) 222.

G. G. Reinwardtii venatione similis, rhizomate breve, paleis fulvis integris 1.5 mm longis lanceolatis basibus stipitum omnino occultis vestito; stipitibus dense caespitosis, ca. 1 cm longis, 0.6 mm crassis, pilis squarrosis rubro-fuscis 2–2.5 mm longis dense obsitis; lamina usque ad 10 cm longa et 7 mm lata, obtusa, deorsum angustata, integra, subcoriacea, subpellucida, pilis 1–2 mm longis dense vestita; venis furcatis, ramo basiscopico fere ad marginem elongato, acroscopico ad gerendum sori tantum sufficiente; soris costalibus, superficialibus, orbicularibus, fuscis, sporangiis setis deciduis parvis ornatis.

NEW CALEDONIA: Mt. Humboldt, alt. 1,500 m. *Schlechter 15346*, distributed as *Polypodium Hookeri*.

Similar to *G. Reinwardtii* and to the Bornean *G. reinwardtioides*, more hairy than either, and in this respect more like *G. Wattsii* and *G. trogophylla*, from both of which and from *G. Hookeri* it differs by the suppressed acroscopic veinlet. The veins are less conspicuous than those of *G. Reinwardtii*, and approach the margin. It differs from all similar species in the complete concealment of the paleae, visible only after careful dissection. The type, in Herb. Lugd. Bat., consists of five ample individuals, but with most of the fronds broken.

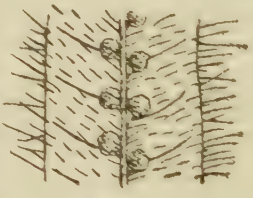

FIG. 16

33. GRAMMITIS DEPLANCHEI (Baker) Copel.

Grammitis Deplanchei (Baker) Copel., Genera (1947) 211.
Polypodium Deplanchei Baker, Syn. Fil. (1867) 322.

Austrogramme Deplanchei Fourn., Ann. Sci. Nat. V **18** (1875) 279 (citing, in error, *Grammitis Deplanchei* Baker).

Grammitis athroosperma Fourn., Bull. Soc. Fr. **16** (1869) 423.

"Rhizome stout, densely coated with stiff spreading dark-brown fibrillose scales; fr. sessile, 6–9 in. l., ⅝–½ in. br., narrowed gradually to both ends, the edge entire or with a few conspicuous blunt teeth about the middle; texture very coriaceous; both sides naked, veins oblique, once forked; sori oblong, oblique, immersed, in close rows in the upper half of the frond near the edge.

"Hab. New Caledonia, *Deplanche*, 5."—Baker l. c.

"Rhizoma horizontale; frondes densae, cartilagineae, subfalcatae, infra in stipitem brevem attenuatae, integrae seu infra grosse dentatae; nervi bifurcati, liberi; sori dorsales in nervis primariis aeque ac in secundariis insidentes, impressi, margini approximati, densisimi, dimidiam partem frondis obtegentes; sporangia aculeo simplici v. ramoso instructa; sporae ovatae."—Fournier (1869).

Paleae 5 mm long, narrowly linear, ciliate with pale setulae; frond 20 to 25 cm long, 1 cm broad, attenuate downward nearly or quite to the rhizome, peculiarly rigid, glabrous, entire or with occasional marginal outgrowths; veins once forked near the costa, sori on the acroscopic and sometimes also on the basiscopic veinlet, sumarginal, somewhat immersed oblong, sometimes extending the length of the fertile veinlet; sporangia bearing a few minute, dark, deciduous setulae.

FIG. 17

A very isolated species, with a superficial resemblance to *G. Whitmeei.*

NEW CALEDONIA: *Pancher; Schlechter 15008; Franc 602, 2027, Rosenstock Fil. Nov. Caled. 42.*

34. GRAMMITIS PSEUDAUSTRALIS Fourn.

Grammitis pseudaustralis Fourn., Bull. Soc. Fr. **16** (1869) 425.

Polypodium pseudaustrale Fourn., Ann. Sci. Nat. V **18** (1875) 282; Copel., U. C. Publ. Bot. **14** (1929) 369.

P. nanum Vieill. in Baker, Syn. Fil. 507, *non* Fée.

P. pumilio Hieron., Hedw. **44** (1905) 102.

"Frondes caespitosae, coriaceae, opacae, 2–3″ longae, 2–3‴ latae, in utraque pagina pilis simplicibus v. ramosis brunneis vestitae; sori subrotundi, dorsales, penitus impressi; sporae ovatae.

"Obs.—Differt a *G. australi* R. Br. pilis qui frondem obducunt; a *G. marginella* Sw., planta antillana, quia frons non nigro-marginata; a *G. pusilla* Blume frondibus basi minus longe attenuatis, soris non orbicularibus."—Fournier (1869).

NEW CALEDONIA: *Balansa 862,* isotype in Herb. Univ. Calif.; *Franc 876, 2001, 2002, Rosenstock Fil. Nov. Caled. 46; Schlechter 15336.*

Paleae hardly 1 mm long, lanceolate, acute, bright-brown, ciliate with pale bristles like those on the frond; fronds essentially sessile, tufted, commonly 2 to 3 cm long, 3 to 5 mm broad, oblanceolate, rounded at apex, attenuate at base, clothed throughout (margin densely) with rusty or pale setulae 0.1 to 0.2 mm long; veins once forked, not reaching the margin, inconspicuous; sorus superficial on the acroscopic branch, which may be prolonged, inframedial to medial, or in very full fruit occupying the whole veinlet, receptacle always elongate; sporangia densely and persistently setulose,—the most so in the genus.

An isolated species. The ciliate paleae and pallid pubescence suggest *G. samoensis*, but the two are very different in other respects.

35. GRAMMITIS BRASSII Copel.

Grammitis Brassii Copel., Philip. Jour. Sci. **60** (1935) 112, *pl. 21.*

"G. caudice paleis lanceolatis fusco-ferrugineis 3 mm longis vestita; stipitibus dense fasciculatis, 5–8 mm longis, validis, pilis brevibus castaneis dense vestitis; fronde usque ad 10 cm longa et 5 mm lata, utrinque angustata, obtusa, firma et vetustate opaca, costa et faciebus ubique setulis minutis inconspicuis vestitis; venis sterilibus simplicibus, fertilibus apud costam furcatis, ramo acroscopico brevissimo soro occulto; soris costalibus parvis, contiguis, orbicularibus, sporangiis setuliferis.

"San Christoval, Hinuahaoro, altitude 900 meters, *Brass 2926*, in moss on tree trunks."—Copeland, l. c.

36. GRAMMITIS HIRTELLOIDES Copel., comb. nov.

Polypodium hirtelloides Copel., Bishop Mus. Bull. **59** (1929) 17.

"Caudice parvo, erecto, inter baseos dense fasciculatos inarticulatos stipitum v. frondium paleis lanceolatis castaneis paucis vestito; frondibus subsessilibus, usque ad 8 cm longis, media longitudine 6 mm latis, utrinque gradatim angustatis, integris, herbaceis, hyalinis, ubique setis atropurpureis 1–2 mm longis obsitis; venis immersis. obliquis, furcatis; soris superficialibus, subcostalibus, sporangiis nudis.

"Gillespie no. 2387, along stream above swimming pool, Nadarivatu, Viti Levu, altitude 1,000 meters.

"Near to *Polypodium hirtellum* Blume of Malaya and China, which is reported from New Caledonia, but of which I have seen no specimen from east of Java and the Philippines. *P. hirtelloides* differs diagnostically in having much darker and more slender paleae."—Copeland, l. c.

Besides the type collection, I have seen only *A. C. Smith 1897*, from Vanua Levu, which conforms perfectly. The brown paleae 1 mm long, are in nature concealed by the densely hairy bases of the stipes; stipes up to 13 mm long, but mostly much shorter, clothed like the lamina, with copious red-chesnut nigrescent hairs; sterile veins simple or forked; sori near the base

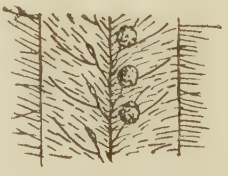

FIG. 18

of an acropetal branch, which may end there, or be little or much prolonged.

Distinguished from *G. conformis* by thinner texture, very hairy fronds, perfectly superficial sori and naked sporangia; from *G. Hookeri,* by being smaller and thinner, therefore with less-branched veins, smaller and rather darker paleae, and naked sporangia. It is related to both species.

Key to Samoan species

Dark margin present ..... 153. *G. Vaupelü*
Dark margin absent.
  Sori medial to supramedial.
    Sori in a regular submarginal row..... 40. *G. Whitmeei*
    Sori irregularly uni- or biseriate..... 42. *G. samoensis*
  Sori costal to medial.
    Stipe hairy.
      Sori superficial or nearly so.
        Veins once forked ..... 37. *G. conformis*
        Veins twice forked.
          Very minutely ciliate ..... 38. *G. Christophersenii*
          Marginal setae over 1 mm long..... 47. *G. Hookeri*
      Sori immersed in large craters..... 39. *G. insularis*
    Stipe naked ..... 41. *G. ligulata*

After the reduction of *Polypodium savaiense* and *P. graminellum,* there remain eight Samoan species,—a most remarkable number, considering the area. Equally remarkable is the paucity of collections, which, if the species were at all alike, would throw doubt on their distinctness. Most surprising is the diversity of the species. Six of the eight (or five, if *P. marginelloides* is *G. Vaupelii*) are, so far as known, endemic, and no two of them are as evidently nearly related as they should be if locally evolved from a common source. This is in sharp contrast with Fiji, where all species are sufficiently related to be of likely local evolution.

37. GRAMMITIS CONFORMIS (Brack.) J. Smith

Grammitis conformis (Brack.) J. Smith, Hist. Fil. (1875) 181.
Polypodium conforme Brack., U. S. Expl. Exped. **16** (1854) 4, *pl. 1, fig. 2,* C. Chr., Bishop Mus. Bull. **177** (1943) 109.

"Rhizomate caespitoso; stipitibus brevibus; frondibus lineari-lanceolatis obtusis basi attenuatis membranaceis glabris ad marginem paullulum repandum costamque setosis; venis furcatis; soris biserialibus approximatis planis rotundis costae proximis; sporangiis echinatis.

"Hab. Ovolau, Feejee Islands; on roots and trunks of trees, at an altitude of 2,000 feet.

"Rootstock caespitose, about half an inch high, imbricated with pale chaffy scales . . . Stipes short and setose. Fronds . . . about 4 inches long . . .; the hairs of a dark brown color.

"This differs from *P. subspathulatum* by the plane sori, and their proximity to the costa; and from *P. Hookeri* by its membranaceous, smooth fronds, and very short stipes."—Brackenridge, l. c.

The type consists of two individuals. The larger is the basis of Brackenridge's statement as to size, and of his figure,—which is a restoration, showing complete fronds, where those of the plant are all broken. These two are probably the entire collection, as I have seen no specimen from the Gray Herbarium.

FIG. 19

Of this larger plant, the paleae are up to 3 mm long narrowly lanceolate, bright-brown turning dark with age; stipes about 5 mm long, setose with brown hairs about 0.5 mm long; lamina 9 mm wide, probably 12 cm long, papyraceous, costa and margin bearing dark setae mostly now about 0.3 mm long but some reaching 1.2 mm, with very sparse long ones on the nether surface; veins forked near the costa, the basiscopic veinlet simple or forked again near the margin, the acroscopic bearing the sorus a little above its base, and usually ending with the elongate receptacle; mature sorus round, subsuperficial; sporangia setulose. I have seen no other specimen matching this.

Brackenridge' smaller plant has fronds folded as well as mostly broken, but is matched by *Betche 102* and *Christophersen 187*, both from Upolu (Samoa), alt. 600 to 700 m. Paleae up to 2 mm long, setulose with bristles uniformly about 0.2 mm long; lamina 6 to 8 cm by 4 to 5 mm, costa freely and margin very densely setulose with bristles 0.15 to 0.2 mm long, surfaces glabrous; costa slender, black; veins once forked, fertile veinlet ending in sorus; sporangia setulose with bristles rather longer than those of the margin.

In spite of the explicit statement as to place of collection, I cannot help suspecting that at least the smaller plant is Samoan. They may or may not be conspecific; the collections are insufficient for a confident judgment.

38. GRAMMITIS CHRISTOPHERSENII Copel.

Grammitis Christophersenii Copel., Bishop Mus. Occ. Papers 15 (1939) 89, *fig. 8*.

"Rhizomate breve, paleis fuscis 1 mm longis ca. 6 cellulis latetudine vestito; stipitibus fasciculatis, vix 5 mm longis nigro-fuscis, validis, setis crassis atro-fuscis 0.2 mm longis dense vestitis; fronde 5–7 cm longa, utrinque angustata, subcoriacea, costa sparse margine densissime setis minutis crassis vestitis, faciebus glabrescentibus; venis furcatis, ramo basiscopico furcato, acroscopico simplice prope basin sorifero; soris magnis, costae approximatis, plerisque contiguis, orbicularibus, receptaculo sub-

elongato, sporangiis setis quam iis stipitis marginisque longioribus munitis. "Samoa: Savaii, above Matavanu, alt. 800 m., "In medium wet forest." *Christophersen* and *Hume No. 2277* in part. April 6, 1931."—Copeland, l. c.

Christensen, in Pteridophyta of Samoa, Bishop Mus. Bull. 177 (1943), does not mention this collection.

Frond 5 mm wide; marginal setulae remarkable for minuteness and denseness; sori superficial. The venation is remarkably irregular; in the commonest, simplest case, the basiscopic branch is once forked, and the simple acroscopic branch is prolonged almost to the margin; but the basiscopic branch, in a frond only 5 mm wide, may be forked again, and more rarely the acroscopic branch may also be forked, under or above the sorus; and casual anastomoses are not rare.

FIG. 20

From *G. conformis* as I have hitherto construed it, this seemed quite distinct. From the small Samoan form, the smaller plant on its type sheet, this differs only in venation, and it is not unlikely that, when better known, they will be found to blend.

39. GRAMMITIS INSULARIS Copel.

Grammitis insularis Copel., U. C. Publ. Bot. 18 (1942) 223.

Rhizomate breve, crasso, paleis brunneis 2–3 mm longis lanceolatis acuminatis vestito; stipitibus 1.5–2 cm longis, 0.7 mm crassis, setis castaneis debilibus usque ad 1 mm longis ornatis; lamina usque ad 17 cm longa et 1 cm lata, coriacea, integra, costa margineque setulis minutis caducis praeditis; venis bis (rarius ter–) furcatis, ramo fertile acroscopico plus minus supra sorum elongato; soris uniseriatis, inframedialibus, in crateris majusculis rotundato-oblongis setulis paucis circumdatis immersis, facie superiore laminae conspicuis, receptaculo in fundo craterae elliptico, sporangiis setulis minutis brunneis munitis.

FIG. 21

SAMOA: *Vaupel 451,* March, 1906, distributed as *Polypodium conforme;* type in U. S. Nat. Herb. No. 1507661. This collection also is uncited by Christensen.

The immersed sori distinguish this species most conspicuously from *G. conformis.* It is much more like *G. subspathulata,* from which it is distinguished by the inframedial sori, more naked fronds, and paleae.

40. GRAMMITIS WHITMEEI (Baker) Copel., comb. nov.

Polypodium Whitmei Baker, Jour. Bot. 14 (1876) 12; C. Chr., Bishop Mus. Bull. 177 (1943) 109.

"Rhizome short-creeping, densely clothed with linear, pale brown, membranous scales under ¼ inch long. Stipe ¼–1 inch long, stiff, erect, densely clothed throughout with conspicuous, spreading, brown, bristly hairs. Lamina simple, ligulate, 6–9 inches long, ½–⅝ inch broad at the middle, narrowed gradually to both ends, thin, subcoriaceous, naked, except a few scattered hairs on the margin. Veins erecto-patent, immersed but distinct, with 1 or 2 branches. Sori round, superficial, terminal, on a branch of main vein, forming a long row nearer the edge than midrib."—Baker, l. c.

Paleae light-reddish-brown, linear, entire, 3–6 mm long. Stipes clustered, not densely, 2 to 3 cm long, 0.8 to 1 mm in diameter, hairs 3 mm long; lamina 20 cm by 16 mm, hairs on costa and margin subdeciduous (a few persistent), not quite wanting on the lamina; venation evident, veins forked ⅓ of the way to the margin, both branches elongate; sori submarginal, on or below end of acroscopic branch, round-oblong, superficial; sporangia freely setulose. Like *G. Deplanchei* in size, and position of sori. The spelling of the specific name by Baker (*Whitmei*, with one *e*) should be regarded as a misprint.

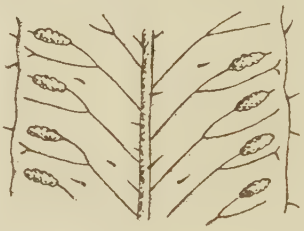

FIG. 22

Isotype in Gray Herbarium; *Vaupel 437* in Philip. Nat. Herb.; *Christophersen 823* in Bishop Museum.

41. GRAMMITIS LIGULATA (Baker) Copel., comb. nov.

Polypodium ligulatum Baker, Syn. Fil. (1867) 320, *non* Copel., Bishop Mus. Bull. 59 (1929) 100, 93 (1932) 71.

P. simplex Baker, Jour. Bot. 14 (1876) 12, *non* Sw.

P. graminellum C. Chr., Index (1906) 530, Bishop Mus. Bull. 177 (1943) 108.

"Stipe short, slender, naked, tufted; fr. 5–6 in. l., ⅛ in. br., ligulate, narrowed gradually towards both ends, the edge very slightly repand; texture subcoriaceous; both sides naked; veins forked; sori round, distant, close to the midrib.

"Hab. Fiji, *Brackenridge*.—Like the preceding (*P. pseudogrammitis*), but the texture thinner, the veins forked, and sori a space from the margin."—Baker, Syn. Fil.

This was evidently segregated from the Brackenridge collection, and I find nothing to fit it in the original Brackenridge set in the U. S. Nat. Herb. I doubt the statement of origin; this is one of several instances in which I suspect Brackenridge of ascribing Samoan collections to Fiji. Locality was of very

minor importance to Brackenridge who, in publication and distrbution, gave one number to what he regarded as a species, no matter how far apart the specimens were collected. Surely in error, I have applied this name to a Fiji specimen, depauperate beyond certain identification, perhaps *G. Hookeri;* and to two likewise stunted Society Islands plants, *G. trachycarpa* and *G. raiatensis.*

Making a succession of tentative keys to the Polynesian species, I now find that *Polypodium ligulatum* and *P. graminellum* always key out together; and then observe that they are supposed to differ in no respect except that the sori of *P. ligulatum* were said to be round, those of *P. simplex* oblong. The latter species I know by an isotype, *Whitmee 123,* in the Gray Herbarium; its receptacles are elongate, but the mature sori are not, or not appreciably so. In the reduction of *P. simplex* Baker (*P. graminellum*), I am confident as one can be without comparison of the types. Mr. Alston has been kind enough to undertake this comparison, but writes that he found at Kew only an empty cover bearing the name, *Polypodium ligulatum.*

Besides this isotype of *P. simplex,* I have *Betche 151* in Herb. Calif. Acad., bearing Prantl's determination as "Polypodium sp., verwandt mit P. conforme Brack. aber nicht identisch," and Christ's as *P. samoense* Baker.

Well characterized by nakedness and minuteness. Paleae rust-brown, concealed by the stipes, 1.5 to 2 mm long, slender, bearing 2 or 3 unicellular hairs at the tip, which are readily lost, leaving the apparently uninjured apex round-apiculate; fronds of the isotype 12 cm, of the Betche specimen 5 cm long; veins leaving the costa at a very acute angle, the fertile ones forked; sorus nearly basal on its fork, which is prolonged above it, hardly at all impressed, but still conspicuous on the upper surface; sporangia bearing minute, dark-chestnut setulae. Not very near to *G. samoensis,* in spite of the divergent terminal cells of the paleae.

Probably endemic in Samoa.

42. **GRAMMITIS SAMOENSIS (Baker) Copel., comb. nov.**

Polypodium samoense Baker, Syn. Fil. (1867) 321; C. Chr., Bishop Mus. Bull. 177 (1943) 110.

P. savaiense Powell in Baker, Jour. Bot. 14 (1876) 344.

"Stipes tufted, 1 in. or less l. slender, brown, clothed with soft spreading brown hairs; fr. 3–6 in. l., 2–3 lin. br., the point bluntish, the edge nearly naked; veins once or even twice forked; the sori small and

sometimes on the point of both veinlets, forming an irregular wavy line near the edge.

"Hab. Samoa, *Powell* 111."—Baker, l. c.

The description of *P. savaiense* differs chiefly in that the frond is described as membranous, "under half an inch broad," and the veins as "erecto-patent, the central ones with 2 to 3 ascending branches on each side, which fall short of the edge and end in sori." These differences might be specific, or they may not; by belief is that in this case they are not. Mr. Alston has compared the types and agrees that they are one species.

FIG. 23

I have seen no authentic specimen of *G. samoensis*. An isotype of *P. savaiense* is in the Gray Herbarium; as to the veins, it conforms to the description of *G. samoensis* if examined where it does so; elsewhere, it is intermediate, but has nowhere 3 veinlets on either side. *Betche 128,* in Herb. Calif. Acad., matches this isotype very perfectly. *Christophersen 3543* in Herb. Bishop Museum, a very perfect specimen, is likewise intermediate, in part closer to the description of *G. samoensis*. *Christophersen* and *Hume 2096,* in the same herbarium, is *P. savaiense* except for being subcoriaceous; the lamina is 10 mm wide in places, the margin there is crenate, and there are 3 acroscopic veinlets. The Bishop Museum specimens are labeled *P. Whitmeei,* ident. C. Christensen, as are also *Christophersen 823* and *Christophersen* and *Hume 2142*, which are real *G. Whitmeei*. *Betche 128* bears Prantl's signed identification as *Polypodium pleiosorum;* Christ, Bot. Jahrb. 23 (1896) 358, accepted this, but wrote on the California Academy sheet "Polypodium Whitmeei Baker, vielleicht synonym mit P. pleiosorum." There is little and superficial resemblance to *G. tahitensis* (*P. pleiosorum*), and some affinity to *G. Whitmeei*.

Rhizome short-creeping, densely clothed with narrowly lanceolate, aciculate, castaneous paleae 2 to 3 mm long, which are ciliate, and sometimes with 2 or 3 setulae at the tip, or with a single seta which may be 1 mm long; stipes 15 to 25 mm long, 0.3 mm thick, the hairs tawny to fuscous, up to 1 mm (or, on the strongest specimen, to 2 mm) long; lamina 10 to 15 cm by 5 to 10 mm, entire or crenate, at first minutely setulose, the margin densely so, eventually glabrescent except for marginal

and costal setulae; veins once to several times forked; sori borne regularly on the end of the first acropetal branch and then medial or slightly extra-medial, less regularly on all other veinlets and then submarginal, forming a second, or even a third imperfect row; sporangia small, setulose. The sori of *Christophersen* and *Hume 2096*, the largest specimen, are scattered rather than seriate, and elongate, only those close to the margin being round.

Key to species of the Society Islands

Black border present. ..... 153a. *P. marginelloides*
Black border absent.
Sori uniseriate.
Stipe over 2 cm long, hairy ..... 45. *G. subspathulata*
Stipe very short, hairy ..... 46. *G. raiatensis*
Stipe about 1 cm long, glabrescent ..... 44. *G. trachycarpa*
Sori pluriseriate or scattered ..... 43. *G. tahitensis*

P. marginelloides is a member of the widely scattered group of *G. marginella*, and related in Polynesia to *G. Vaupelii*, if not that species. *G. tahitensis* is an isolated species. The other three are mutually related, members of the group of *G. Hookeri* and *G. conformis*, but sufficiently distinct, and all endemic.

43. **GRAMMITIS TAHITENSIS (C. Chr.) Copel., comb. nov.**

Polypodium tahitense C. Chr., Index (1906) 569.
P. pleiosorum Mett., Linnaea 36 (1869) 128, *non* Hooker (*pleiosoros*).

"Rhizoma repens, abbreviatum, tenerum, paleis membranaceis flaccidis, rufidulis, 3‴ longis, lingulatis, acuminatis, integerrimis apice setiferis dense vestitum; folia approximata, membranacea, pellucida, in otroque pagina pilis brevibus cinnamomeis dense pubescente ciliata, petiolus 6′ ″ longus, tener, fuscus, patenti molliter setosus; lamina 4″ longa, 3‴ lata, linearis basi longius, apice brevius attenuata, margine levissime sinuato-repanda, rarius irregulariter laciniata; nervi translucentes, densi, sub angulo 40° decurrentes infimi furcati, plerique anadrome trifurcati vel ramis 1–2-pinnati, apice attenuati, rami antici, hinc et postici infimi marginem non attingentes, rarius confluentes vel omnes liberi plerumque ramo terminali excepto soriferi; sori bis tertium partem superiorem laminae occupantes, utrinque ad costam bi-quadriseriatim sparsi, serie interna costae subapproximata ovales dorsum nervorum occupantes s. subapicales s. apicales, superficiales; sporangia seta abbreviata obsita; sporae globosae.

"Ins. Societatis, Tahiti. (Vesco, Lepine).

"Inter species *Polypodii generis* lamina indivisa gaudentes soris ad costam utrinque pluriseriatis insigne; nervis autem variat liberis et anastomosantibus, ramis sorum singulum s. plures procreantibus more Metaxyae . . ."—Mettenius, l. c.

TAHITI, endemic: The type, not seen; *MacDaniels 1546; Grant 3927 partim, 3928, 4250,* alt. 600 to 1,400 m.

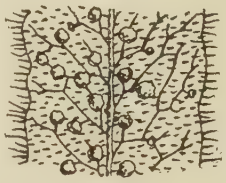

FIG. 24

Paleae 5 by 0.5 mm, pale-brown; stipes 5 to 14 mm long, densely beset with "cinnamon" hairs about 1 mm long, as are the fronds throughout. The description, as is usual with Mettenius, is good, but the fronds are commonly broader than stated, 1 cm or more; including the laciniations referred to in the description, the width of one of MacDaniels' fronds is 2.6 cm. Receptacles narrowly elliptic; maturing sporangia copiously setulose.

44. GRAMMITIS TRACHYCARPA (Mett.) Copel.

Grammitis trachycarpa (Mett.) Copel., Bishop Mus. Occ. Papers 14 (1938) 72.

Polypodium trachycarpum Mett., Linnaea 36 (1869) 127.

"Rhizoma caespitosum, paleis membranaceis, rufis, 2‴ longis, oblongo-lanceolatis, acuminatis squamosum, folia multifaria, membranacea, pellucida, glaberrima, sessilia, ad 3⅓″ longa, 2½″ lata, lanceolata s. spathulato-linearia; nervi manifesti, furcati, sub angulo 20–30° decurrentes; ad marginem apice attenuato excurrentes; sori in basi rami antici costae approximati, superficiales, rotundati; sporangia setis binis rigidis brevibus obsita.

"Ins. Societatis, Tahiti (Vesco).

"Glabritie foliorum a *P. subpinnatifido* Bl. et aff.; setis sporangia ornantibus ab *P. sessilifolio* Hook. recedens.

"Nervi apice aequales. vix incrassato superficiem petunt."—Mettenius, l. c.

Specimens seen: Tahiti: *Grant 3927 partim* (mostly *G. subspathulata*); Tahaa: *Grant 5182;* Huahine: *Grant 5313, St. John 17166;* all conforming reasonably to the description except as to the paleae, which in these specimens are 1.5 to 2 mm long, 0.3 mm broad, slate-brown. Fronds up to 18 cm long by 6 mm wide, such large ones subundulate, commonly about 10 by 0.5 cm and entire; growing fronds with a few very slender marginal hairs, glabrescent; sori near the base of the acroscopic veinlets, which are then prolonged nearly to the margin; receptacle short-elliptic; setulae on the sporangia oftenest solitary (even if plural on the sporangium), rarely even ternate. *Grant 5224,* from Raiatea, is probably a dwarf form of this species.

FIG. 25

45. GRAMMITIS SUBSPATHULATA (Brack.) Farwell

Grammitis subspathulata (Brack.) Farwell, Am. Midland Nat. 12 (1931) 294, *quoad nomen.*

Polypodium subspathulatum Brack., U. S. Expl. Exped. XVI (1854) 3, *pl. 1.*

"P. rhizomate caespitoso; frondibus paucis, sterilibus spathulatis stipitatis integris coriaceis labris; fertilibus lineari-lanceolatis basi attenuatis margine cum stipite sparsim setosis; venis furcatis; soris biserialibus distantibus subimmersis fere ovalibus; sporangiis echinatis.

"Hab. Tahiti, Society Islands: on trunks in mountain forests.

"Fronds few and very dissimilar in form; the sterile one, including the short stipe, 1 to 1½ inches high; . . . the fertile, 4 to 5 inches in length, . . . short and brown setae."—Brack., l. c. Sori midway between costa and margin.

Apparently common in Tahiti: *Brackenridge*, the type, in U. S. Nat. Herb.; *Quayle; MacDaniels 1454; Grant 3750, 3767, 3927, 4243; St. John* and *Fosberg 17122, 17149.*

Paleae conspicuous, 2 to 3 mm long, 0.6 mm wide at base, brown; stipe 2 to 3.5 cm long, its hairs 2 mm long, abundant but fragile, reddish-brown becoming dark; lamina up to 19 cm long, commonly 5 to 8 mm broad (one frond 10 mm broad has some sori outside the regular series), setae on costa and margin dark, fragile, almost wanting on old fronds, texture coriaceous or nearly so; veins forked near the base, the basiscopic branch usually forked again near the margin; sorus round or slightly elongate, terminal or subterminal on the long acroscopic branch, extramedial or rarely submarginal, impressed and marked by slight elevations of the upper surface; young sporangia protected by copious dark-chestnut bristles.

FIG. 26

The type is a mixture, consisting of two fertile fronds, and two little sporeling plants, so young that I do not recognize them, but not *Grammitis.* These sporelings are responsible for the specific name; but I must still credit Brackenridge with knowing the genus of his plant, and construe the fertile fronds as the type of the species.

46. GRAMMITIS RAIATENSIS (J. W. Moore) Copel.

Grammitis raiatensis (J. W. Moore) Copel., Bishop Mus. Occ. Papers 14 (1938) 72.

Polypodium raiatense J. W. Moore, Bishop Mus. Bull. 102 (1933) 10.

"Rhizoma breve repens vel suberectum squamosum, squami ovato-lanceolati vel lanceolati acuminati integri stramineofusci nitidi translucidi ad 3 mm. longi, folia 3–5 cm. longa, petioli 1–2 mm. longi circa ½ mm. crassi fuscissimi pilis setaceis rufo-fuscis circa 1 mm longis instructi, laminae 3½–5 mm. latae simplices (raro furcatis) prope lineares integrae

subcoriaceae quam juvenales tandem coriaceae marginibus ciliatae atque et supra et infra praesertim in costis pilis rufo-fuscis pubescentes, abrupte attenuatae 3–5 mm. infra apicem in summitatem obtusam vel acutam ad basin sensim attenuatae in petiolum, nervi plurimes proximi simplices vel medio inter costam et marginem 1-furcati obscuri in foliis vetis sed in foliis juvenibus sat evidentes luce transmissa, sori contigui prope costam ovati confluentes senectute, sporangia cum vel sine appendicibus spinosis 280 × 255μ, sporae 51 × 46μ.

"Field number 183, October 7, 1926, altitude 400 meters; on moist rocks along stream, Mt. Temehani. Endemic.

"*Polypodium raiatense* differs from *Polypodium ligulatum* Baker in having shorter fronds which are rather conspicuously broadened in the fertile apical portion and more or less hairy on both surfaces. The forked veins are fewer and the sori are continguous instead of distant."—Moore, l. c.

Polypodium raiatense, var. *temehaniense* J. A. Moore, Bishop Mus. Bull. **102** (1933) 11.

"Speciei similis magnitudine et forma sed debus sequentibus differt: petiolus et lamina prope glabra, simplices nervi pauciores, nervi alii propius costae quam margini furcati, sporangia 248 × 208μ, sporae 50 × 46μ.

"Field number 104, September 21, 1926, altitude 470 meters; on moist rocks and *Pandanus* stems, swamp of Temehani Plain. Endemic."—Moore, l. c.

I have seen, but do not have, the type collections. *St. John 17287* is representative and from the type locality. *Grant 5237* is a small form. I do not find the paleae broader than lanceolate. Stipes are up to 1 cm long, usually shorter; base of lamina decurrent; veins nearly all forked except where the frond is contracted, fertile veinlets usually prolonged beyond sorus, anastomoses occasional, even on fronds only 5 mm broad; sorus slightly impressed, receptacle broadly elliptic, sori longer than wide, crowded, infra-medial (not costular). The dark setulae are abundant on maturing sporangia, but, as in other species, disappear with maturity.

Apparently local on Raiatea, sharing the characteristics of *G. Hookeri* and *G. subspathulata.*

Key to Hawaiian species

Rhizome long-creeping, fronds very narrow ..... 50. *G. tenella*
Fronds clustered, less extremely narrow.
  Fronds appreciably hairy ..... 47. *G. Hookeri*
  Fronds glabrescent.
    Paleae pale-brown ..... 48. *G. Baldwinii*
    Paleae very dark ..... 49. *G. oahuensis*

G. tenella is an isolated species, the affinity of which eludes me. *G. Hookeri* is the only species known outside Hawaii. Its

hairy form suggests that it may be related to the group of *G. fasciculata,* ranging from Lord Howe across Malaya. *G. Baldwinii* is evidently a local derivative of *G. Hookeri. G. oahuensis* is probably of the same affinity; small fronds suggest *G. tenella,* but the rhizome is altogether different.

There is also in Hawaii the rare and variable *Polypodium haalilioanum,* which resembles *Grammitis* in form, but has the pubescence of *Amphoradenium.*

47. GRAMMITIS HOOKERI (Brack.) Copel., comb. nov.

Polypodium Hookeri Brack., U. S. Expl. Exped. XVI (1854) 4.

P. setigerum Hooker and Arnott, Bot. Beech. Voy. (1832) 103, *pl. 21A, non* Blume.

Grammitis setigera J. Smith, Hist. Fil. (1875) 181.

"Fronde simplici lineari-lanceolata brevissime stipitata utrinque margineque pilis rigidis sparsis atro-purpureis, soris biserialibus approximatis rotundatis setosis.

"Radix caespitosa fibrosa. Stipites 5–6 ex eadem radice, brevissimae. Frondes vix digitales, lineari-lanceolatae, subcoriaceae, obtusae, flavo-virides, costa obscura, basi attenuatae . . . Capsulae setis immixtae."—H. & A., l. c.

Like so many Hawaiian ferns, this is an exceedingly variable species. Rhizome 1.5 mm thick, or, including the dense scales, indefinitely thicker, paleae pale-brown, 3 mm long, lanceolate, obtuse; stipes ranging from less than 1 cm, as originally described, to 5.5 cm long, fairly uniform on the individual plant; lamina from 18 by 0.9 cm (linear, narrowed from the middle to both ends) to 11 by 1.4 cm (elliptic, obtuse, with cuneate base), herbaceous to subcoriaceous, sparsely hairy with hairs 1 to 1.5 mm long to densely setose with hairs 2 to 2.5 mm long; veins simple near the ends of the fronds, ending in intramarginal dots, very variable in the broader parts, — uniformly once forked, or regularly twice forked, or the basiscopic branch twice forked,—the fertile branch usually more or less prolonged beyond the sorus; sori usually subcostal, sometimes inframedial, or even (*Rock 6111*) supramedial, the sori being then far from the base of the veinlet, superficial or sometimes evidently impressed. This variety of forms might represent two or more species, but they intergrade. There might be a darker, coriaceous, very hairy species with broader fronds, and one with linear, thinner, more naked fronds, the intermediates being regarded as hybrids; but it is easier and simpler to regard the entire range as constituting one variable species. *Baldwin 81* in U. S. Nat. Herb. (Baldwin specimens usually bear no number) is quite abnormal, with a few long

segments running out from the margin, each served by a freely branched vein, conspicuously elongate sori, and a few sori abnormally placed. Young sporangia always bear several setulae.

Hawaiian collections are numerous. To illustrate the diversity, I may cite *Rock 248, 4107, 6111* and *8421.*

Grammitis Hookeri has been reported elsewhere, from Samoa, Fiji, Lord Howe, New Guinea and the Philippines. Samoan (*Powell, Betche*) and Fiji (*Gillespie 4109, A. C. Smith 903*) specimens are variable within the range found in Hawaii. The Lord Howe plant is *G. Wattsii;* that from the Philippines (*Brackenridge*), *G. Reinwardtii.* I have seen no specimen responsible for the New Guinea citation.

48. GRAMMITIS BALDWINII (Baker) Copel., comb. nov.

Polypodium Baldwinii Baker, Ann. Bot. 5 (1891) 463.
P. Knudsenii Hieron., Hedw. 44 (1905) 79.

"Rhizome short-creeping; paleae dense, small, linear-oblong, obtuse. Stipe none or very short. Frond simple, ligulate, subcoriaceous, glabrous, 3–5 in. long, 1 in. broad at the middle, narrowed gradually to the base. Veins distinct, ascending, with 2–3 branches. Sori globose, superficial, sugmarginal, 1/12 in. diam. Sandwish Isles, Baldwin. Received from Professor Eaton, of Yale."—Baker, l. c.

Paleae yellowish-brown, 3 mm long, up to 1 mm broad; stipes 5 to 10 mm long; lamina up to 18 by 1.1 cm, entire or rarely undulate, long-attenuate to both ends, subcoriaceous, with sparse deciduous marginal setulae; fertile veins forked well above the base, sorus terminal on the long acropetal branch, therefore extramedial or submarginal; receptacle elongate, sorus slightly so; sporangia setulose.

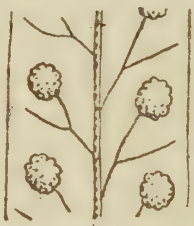

FIG. 27

HAWAII: known only on Kauai, at considerable altitude, *Heller 2708; Rock 1391;* and, *teste* Hillebrand, *Baldwin, Knudsen, Wawra.*

With Hillebrand (who, however, followed Luerssen in treating this as a variety of *Polypodium samoense*), I regard it as related to the more naked, firmer, narrower and shorter-stalked form of *G. Hookeri.*

49. GRAMMITIS OAHUENSIS Copel., nom. nov.

Polypodium pumilum Robinson, Bull. Torrey Bot. Club 40 (1913) 195, *fig. 1. non* Brause (1912).

"Rootstock short, erect, less than 1 mm. in diameter, covered with dark brown, linear-lanceolate scales 1–2 mm. long and 0.3–0.5 mm. broad at the base, with 6–10 rows of cells in the broadest part; roots numerous; leaves 3–5, simple, nearly sessile, cespitose, linear-oblanceolate, obtuse or

bluntly acute at apex, narrowed gradually at the base, 4–7 cm. long, 3–5 mm. wide, the margin subentire, the midrib green, prominent; veins forked once about 2 mm from the midrib; sori oblong, 1.5–2 mm. long by 1–1.5 mm. broad; sporangia flattened laterally, the annulus of 10–12 cells; spores yellow, tetrahedral, 0.04 mm. in diameter, very minutely tuberculate.

"Type collected on Oahu, 1000 m. elevation, 1890, by D. D. Baldwin, distributed by D. C. Eaton as *P. sessilifolium* (Herb. N. Y. Bot. Gard.).

"The present species differs from *P. Knudseni* Hieron. in its smaller size; in the size of the scales, which in the latter are 3–4 mm. long and 0.5–0.8 wide, with 10–20 rows of cells in the broadest part; and in the smooth margin of the leaf in contrast with the hairy margin of *P. Knudseni*."—Robinson, l. c.

HAWAII: Oahu. Known to me by *Degener 10165*, in U. S. Nat. Herb. and Herb. N. Y. Bot. Garden, from Waimahu on "moss-covered rocks in dry lantana region," which conforms to the description except that the paleae, being really linear-lanceolate, are only 0.3 mm broad, and attenuate to the apex; also, by *Wegner and Grether 3333*, and several subsequent collections by Wagner. Growing fronds bear a few minute whitish hairs which disappear completely by the time growth ceases. The sporangia are without bristles. The statement that the veins fork 2 mm from the costa is an evident misprint.

50. GRAMMITIS TENELLA Kaulf.

G. tenella Kaulf., Enum. (1824) 84.
Polypodium pseudo-grammitis Gaud., Freyc. Voy. (1827) 345; Hooker and Arnott, Bot. Beech. Voy. (1832) 103, *pl. 21B*.
P. Kaulfussii Presl, Tent. (1836) 178.

"G. frondibus linearibus obtusis glabris repandis, soris oblongis raris, caudice filiformi paleaceo.

"Habitat in Oahu insularum Sandwich. Chamisso.

"Caudices repentes ramosi; radiculae ferrugineo-hirtae. Frondes magnitudine perquam variant, nunc sesquipollicares nunc semipedales, vix lineam latae, debiles, glabrae, leviter repandae, in stipitem brevissimum filiformem attenuatae. Sori parvi ovati vel oblongi, tres seu quinque in fronde sparsi. Venae simplices; in Gram. lineari autem et Billardieri bifidae, ramulus nempe superior costae subparallelus, inferior obliquus."—Kaulfuss, l. c.

Rhizomes long-creeping and intricate, 0.6 mm in diameter, sparsely clothed with castaneous, fuscescent, acute paleae a scant millimeter long; fronds 3 to 17 cm long, 1.5 to 5 mm wide, commonly 5 to 10 cm by 2 mm, glabrous except for a few minute, caducous marginal hairs; sterile veins normally simple, rarely forked; sori normally borne on a very short acroscopic branch, sometimes on an apparently simple vein, the fertile branch very rarely

FIG. 28

prolonged, receptacle elongate, but sorus approximately round, large and not rarely as wide as the frond, over-reaching the margin, remote and irregularly spaced, sporangia naked.

The fronds may be "leviter repandae," but are more commonly entire. An abnormal frond of *Yuncker 3050,* broadly and shallowly serrate in the lower part, is interesting because it suggests *Polypodium haalilioanum* and *P. Saffordii.*

HAWAII, endemic: over forty collections in hand, including isotype of *P. pseudo-grammitis* and probable isotype of *G. tenella* in Herb. Lugd. Bat.

51. GRAMMITIS MILTIBLEPHARIS Copel.

Grammitis miltiblepharis Copel., Bishop Mus. Occ. Papers **14** (1938) 71, *pl. 23.*

"Rhizomate breve adscendente, paleis laete ferrugineis 2 mm longis basi 1 mm latis acutis integris membranaceis vestito; stipitibus caespitosis, aut usque ad 8 mm longis aut ob laminam decurrentem subnullis, setis vix 1 mm longis haud dense vestitis; lamina 4–5 cm longa, 3–3.5 mm lata, lineari-oblanceolata, obtusa subcoriacea, superfie sparsius costa et margine dense setis 0.3–0.4 mm longis rubido-castaneis vetustate fuscescentibus vestita; venis sterilibus plerisque simplicibus, intra marginem liberis, fertilibus furcatis; soris prope bases ramorum acroscopicorum fere costalibus, vix elongatis, sporangiis setiferis.

"Marquesas: Nukuhiva, Ooumu, altitude 1,100 meters, "Epiphytic on mossy branches in damp forest," Mumford and Adamson no. 586 (mixed with. *G. marginelloides*).

"This is likely to be *Polypodium Hookeri* variety *uapense* E. Brown (Bishop Museum Bull. 89, p. 86, 1931) . . . It differs from *Grammitis conformis* (Brackenridge) J. Smith as described, in smaller size and in bearing hairs on the surface; and from *Polypodium Hookeri,* in smaller size, thinner texture, and much shorter hairs . . ."—Copeland, l. c.

Known to me by the type collection only. The marginal setulae are sometimes clustered. The lamina, in spite of being firm in texture, is pellucid, and the veins are coarse.

FIG. 29

52. GRAMMITIS MAIREAUI Copel.

G. Maireaui Copel., Bishop Mus. Occ. Papers **14** (1938) 71, pl. 22.

"Rhizomate repente, cum paleis 5 mm crasso, paleis fuscis 3 mm longis, 1 mm latis, obtusis integris immerso; stipitibus approximatis 3–5 cm longis, setis atropurpureo-fuscis horizontalibus 1 mm longis dense vestitis; fronde usque ad 20 cm longa et 16 mm lata, utrinque angustata, integra vel rarius minute crispata, costa et margine minutius setiferis, firme papyracea, translucente, venis 3–4-furcatis, soris ad ramos infimos acroscopicos dorsalibus, subcostalibus, superficialibus orbicularibus sed receptaculis elongatis, sporangiis setiferis.

"Rapa: Taratika, east side of Mount Perahu, on mossy trunk in rain forest, altitude 550 meters, July 15, 1934, St. John and Maireau no. 15553.

"A relative of *Grammitis subspathulata* of Tahiti, distinguished by having superficial sori nearer to the midrib than to the margin; also, the paleae are darker, and the fronds thinner and broader."—Copeland, l. c.

Known by the type collection only.

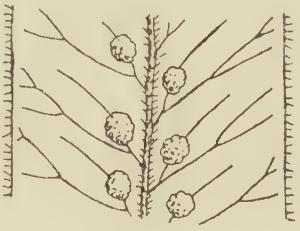

FIG. 30

53. GRAMMITIS PONAPENSIS Copel.

Grammitis ponapensis Copel., Bishop Mus. Occ. Papers **15** (1939) 88, *fig. 7.*

"Rhizomate breve, 2 mm crasso, paleis castaneis 3–4 mm longis linearibus pallide ciliatis dense immerso; stipitibus confertis, 2–5 cm longis, rigidis, setis cinereis vel fuscis 0.2 mm longis densissime velutinis; fronde usque ad 15 cm longa et 11 mm lata, utrinque angustata, integra, subcoriacea, pilis pallide fulvis 0.5–0.9 mm longis dense ciliatis et ad facies ambas adspersis; venis 2–5-ramosis; soris typice (in evolutione plena plantae) irregulariter pluriseriatis, superficialibus, oblongis, sporangiis nudis.

"Caroline Islands: Ponape, Tolomail, on tree trunks. *M. Takamatsu* No. 950. February, 1936.

"The most remarkable feature of this species is the diversity in shape and insertion of the sori. On about half of the fronds, construed as not representing the plants in full development, they are in single, regular subcostal rows, and then, a/, completely occupying the short lowest acropetal branch; or b/, occupying the distal part of a branch not so extremely short; or c/, dorsal on a branch prolonged above the sorus. On wider, whether or not longer, fronds, they are pluriseriate, commonly on both acroscopic and basiscopic branches, and these fertile lower branches most often reduced, not extending beyond the sori; but on the upper, and rarely on all branches, they are likely to be dorsal, the fertile branches extending nearly to the margin. In form, the sori vary from round to more than twice as long as wide."—Copeland, l. c.

Known by the type collection only. Related to *G. samoensis,* distinguished by larger paleae with pale hairs, hairy fronds, and larger sori nearer to the costa. Correcting the original description,—the sporangia bear a few weak hairs.

FIG. 31

54. **GRAMMITIS SCLEROGLOSSOIDES Copel.**

Grammitis scleroglossoides Copel., Bishop Mus Occ. Papers **15** (1939) 86, *fig. 6.*

"Rhizomate brevirepente, paleis ferrugineis 4–5 mm longis 0.6–0.8 mm latis integris plerisque acutis occulto; stipitibus approximatis (subfasciculatis), 1 cm longis, fuscis, pube brevissima castanea vestitis; fronde usque ad 17 cm longa, 4–7 mm lata, utrinque attenuata, integra, coriacea, olivaceo-viride, setis brevissimis atropurpureis aut solitariis aut geminatis perpaucis nisi inferne ad costam mox deciduis sparsa et ciliata; venis immersis, 2–3-ramosis, rarissime anastomosantibus; soris subcostalibus, approximatis et saepe imbricatis, leviter immersis, oblongis, 2–3 mm longis, typice oblique positis, interdum curvatis, rarius costae parallelis et hic illuc confluentibus, sporangiis nudis.

"Caroline Islands: Ponape, Mt. Nan-a-laut. *M. Takamatsu*, No. 1095, February, 1936.

"This is a typical enough *Grammitis*, but its affinity to *Scleroglossum* is unmistakable, shown by the sometimes geminate minute and deciduous setae as well as by the sometimes parallel and confluent sori. In *Grammitis*, it is related to *G. pleurogrammoides* . . . and *G. locellata* . . ., both of New Guinea, with sori more deeply immersed and, so far as known, always parallel to the costa."—Copeland, l. c.

Known by the type colection only. Not near to any Polynesian species. Its affinity seems to be to *G. pleurogrammoides*, from which it is distinguished by pubescent stipe, longer fronds, closer and more oblique sori, and naked sporangia,— differences too great to permit the idea of close affinity.

FIG. 32

COMMENT ON PACIFIC ISLAND GRAMMITIS

The first and strongest impression given by the species of this vast area of water and very little land is the extreme localization of the species. Lord Howe Island has three species; New Caledonia, three; San Cristobal, one; Fiji, two to four; Samoa, eight; the Society Islands, five; Hawaii, four; the Marquesas, two; Rapa, one; Ponape, two. More will be found in the Solomons; probably a few more elsewhere. Of all these species, only *G. Hookeri, G. conformis, G. ligulata* and *G. marginelloides* (a marginate species) appear more than once in this list. In the cases of *G. conformis* and *G. ligulata*, it is suspected that they are Samoan endemics, accredited to Fiji by mistake. One marginate species may range from Samoa to the Marquesas. With this possible exception, *G. Hookeri* is the only species regarded as widespread.

Described from Hawaii, *G. Hookeri* has been ascribed to places as remote as Lord Howe Island, Queensland and New Guinea; and I have left under that name specimens from Samoa and Fiji. This occurs because it is in Hawaii a most indefinite species, comprehending a range of forms which might constitute an indefinite number of species, but which seem to blend in Hawaii. As a matter of convenience, a Samoan plant which can be matched approximately by any of these Hawaiian forms is given this name. The effect is that it is a group, rather than a species in the usual sense. As a group, including related forms regarded as species, it does range well over the Pacific, and includes about half of the species of the region. And, as a group, it has relatives, the group of *G. fasciculata,* ranging to Asia.

Some other Pacific species show some measure of affinity to those of New Guinea and Malaya. Thus, *G. samoensis* and *G. ponapensis* have ciliate paleae and pluriseriate sori in common with *G. Frederici-et-Pauli. G. tahitensis* has awn-tipped but not ciliate paleae, and is less intimately a member of the same group. *G. scleroglossoides* has relatives in New Guinea. Micronesia would perhaps better be regarded as an appendage of New Guinea than of Polynesia. Wherever it be treated, its two species are endemic.

G. tenella suggests American affinity. There is an element in the Hawaiian flora which suggests origin from Antarctic America, distinct from continental America farther north, and *G. tenella* may be a part of this element. It has, however, a relative, *Polypodium Saffordii,* which seems likely to have had a direct source in tropical America, in *Xiphopteris;* and if this route of colonization is responsible for *P. Saffordii,* it was equally open for *G. tenella.*

The New Caledonian *G. Deplanchei,* with freely soriferous basiscopic veinlet and other only less peculiar features, is one of the most isolated species in the genus; and its coendemic, *G. pseudaustralis,* is also without any known near relative.

To summarize: Polynesia is a region of high endemism, and is properly regarded as an independent geographic area. In the complete absence of common species, the existence of related species shows that some affinity exists between the floras of Polynesia and New Guinea. *Grammitis* in both regions being

of austral origin, the streams of colonization seem to have diverged before reaching either area.

Key to the New Guinea species

Stipes naked or glabrescent.
- Sori superficial or nearly so.
  - Stipe at least half as long as lamina ..... 55. *G. caricifolia*
  - Stipe relatively short.
    - Lamina not over 5 cm long ..... 56. *G. oblanceolata*, *G. reducta*, *P. viridulum*
    - Lamina 7–15 cm long ..... 57. *G. stanleyana*, *P. trichocarpum*
    - Lamina longer.
      - Fronds 3 mm wide ..... 58. *G. graminifolia*
      - Fronds 5–6 mm wide ..... 59. *G. frigida*
      - Fronds 10–12 mm wide.
        - Stipe 0–2 cm long ..... 60. *G. subfasciata*
        - Stipe 3–8 cm long ..... 61. *G. integra*
- Sori impressed or immersed.
  - Stipe longer than fertile lamina ..... 63. *G. interrupta*
  - Stipe shorter than lamina.
    - Stipe 4 cm long or longer.
      - Sori in deep clefts ..... 67. *G. locellata*
      - Sori in open depressions ..... 64. *G. plurisetulosa*
    - Stipe 0–2 cm long.
      - Soral pits close together ..... 62. *G. pleurogrammoides*
      - Soral pits not contiguous.
        - Borders of pits naked ..... 65. *G. loculosa*
        - Borders of pits hairy ..... 66. *G. dictymioides*

Stipes hairy.
- Bases of stipe-hairs enlarged.
  - Sori impressed, uniseriate ..... 69. *G. scabristipes*
  - Sori superficial, some scattered ..... 70. *G. novoguineensis*
- Bases of hairs not enlarged.
  - Fronds small, thin, paleae undeveloped.
    - Hairs of frond under 0.5 mm long ..... 71. *G. coredrosora*
    - Hairs over 1 mm long ..... 72. *G. parva*
  - Fronds mostly larger, paleae developed.
    - Sori deeply immersed.
      - Soral pits open, oblong ..... 65. *G. loculosa*
      - Pits linear, opening at maturity ..... 68. *G. stomatocarpa*
    - Sori superficial or moderately impressed.
      - Stipes velutinous, hairs up to 0.6 mm long.
        - Veins normally once forked ..... 73. *G. mesocarpa*
        - Veins forked more than once.
          - Sori rather scattered ..... 74. *G. sumatrana*
          - Sori regularly seriate ..... 75. *G. subrepanda*, *P. torricellianum*, *P. carstenszense*

Stipes with deciduous short hairs, hairs of stipe 1 mm long or longer. 59. *G. frigida*
Laminar surface naked.
Veins simple ..... 79. *P. sucklingianum*
Veins once forked, veinlets equal.
Stipe densely hairy ..... 80. *G. ciliolata*
Stipe sparsely hairy ..... 81. *G. ceratocarpa*
Veinlets more numerous, unequal.
Stipe sparsely hairy.
Stipe 5–10 cm long ..... 77. *G. Archboldii*
Stipe 1–2 cm long ..... 78. *P. diplosoroides*
Stipe moderately hairy ..... 82. *G. dolichosora*
Stipe densely hairy ..... 100. *G. knutsfordiana*
Laminar surface more or less setose.
Sori partly scattered ..... 76. *G. subreticulata*
Sori strictly uniseriate.
Fronds sessile ..... 83. *P. papuense*
Fronds stipitate.
Fertile veinlet ending in sorus.
Veins once forked.
Margin inciso-crenate 84. *G. Mariae*
Margin entire.
Frond 10 cm × 3 mm 85. *G. hirtiformis*
Frond 10 cm × 7 mm 86. *G. matapensis*
Frond much larger 92. *G. ornatissima*
Veins twice forked.
Hairs sparse and long.... 100. *G. knutsfordiana*
Bristles minute, dense..... 101. *G. hispida*
Fertile veinlet prolonged.
Stipe 1/10 as long as lamina.
Frond densely hairy..... 91. *G. habbemensis*
Frond sparsely hairy..... 90. *G. inconstans*
Stipe relatively long.
Frond ca. 3 cm long..... 99. *G. murrayana*
Frond larger.
Veins once forked.
Veins at about 45°.
Fronds moderately hairy.
Densely ciliate..... 95. *G. cyclosora*
Sparsely ciliate.
Veins approaching margin ..... 88. *G. Myer-Dreesii*
Veins far from margin ..... 89. *G. brevisetulosa*
Fronds extremely hairy ..... 94. *G. trogophylla*

Veins at an acute angle.
Stipe weak ..... 87. *G. debilifolia*
Stipe firm ..... 93. *G. mollipila*
Veins more divided.
Apex attenuate.
Paleae brown ..... 96. *G. trichopoda*
Paleae black ..... 97. *G. nigropaleata*
Apex abrupt ..... 98. *G. fasciculata*

Monstrosities with repeatedly furcate fronds: ..... 102a *P. fuciforme*; 102b *P. alcicorne*; 102c *P. dichotomum*

55. GRAMMITIS CARICIFOLIA Copel.

Grammitis caricifolia Copel., U. C. Pub. Bot. 18 (1942) 223.

Rhizomate adscendente, 1–2 mm crasso, paleis fulvis 3–4 mm longis basi 1 mm latis vestito; stipitibus approximatis, erectis, 2–3 cm longis, gracilibus, fuscis, glabrescentibus; lamina 4–5 cm longa, 2 (rarius 3) mm lata, utrinque attenuata, laete viride, coriacea, glabra; venis omnino occultis, brevibus, unifurcatis, soros ramos acroscopicos complentibus, superficialibus vel leviter immersis, costalibus, oblongis, 1 mm longis, expansis contiguis et laminae partem fertilem obtegentibus, sporangiis setulis atrocastaneis deciduis armatis.

FIG. 33

NEW GUINEA: Morobe, Mt. Sarawaket, "12 to 14,000 feet, on Cyathea in open place." *Mary Strong Clemens s. n.*
To this species I refer also *Brass 9410*, from Mt. Wilhelmina, Dutch New Guinea, alt. 3,440 m, epiphytic.

The stipe is sometimes as long as the lamina, always more than half as long. The long stipes are so characteristic that I feel unable to identify this as *G. frigida*, whether or not I identify that species correctly. Mr. Alston refers here *MacGregor 33*, from Mt. Victoria. Because *G. frigida* has also a rather long stipe, he regards *G. caricifolia* as the same species. They are certainly related.

56. GRAMMITIS OBLANCEOLATA (Baker) Copel., comb. nov.

Polypodium oblanceolatum Baker, Ann. Bot. 8 (1894) 128.

"Stipitibus brevibus filiformibus nudis, frondibus simplicibus oblanceolatis obtusis crenulatis membranaceis utrinque viridibus glabris paleis paucis brunneis subulatis praeditis ad basin sensim attenuatis, venis perspicuis laxe dispositis furcatis, soris superficialibus globosis inter costam et marginem medialibus uniseriatis ad furcam venarum productis.

"Hab. New Guinea, Mount Suckling. Gathered by Sir W. Macgregor in 1892. Sent to Kew by Sir F. Mueller.

"Lamina 1½–2 poll. longa, 2 lin. lata.

"Near *P. ligulatum*, Baker and *P. subevenosum*, Baker."—Baker, l. c.

I have seen no original specimen but have *Carr 13665* determined by Alston. *Polypodium reductum* differs in having much narrower fronds.

FIG. 34

56a. GRAMMITIS REDUCTA (v.A.v.R.) Copel., comb. nov.

Polypodium reductum v.A.v.R., Nova Guinea **14** (1924) 41.

"*Eupolypodium, Integrifolia.*—Rhizoma breviter repens, subcaespitosum, squamulis parvis, acute ovatis, pallide ferrugineis, nitidis, integerrimis. Stipites approximati, filiformes, 0–1½ cm. longi, glabri. Frondes ± coriacei, glabrae, supra obscure virides, in sicco fuscae, subtus pallidiores, anguste lineari-cuneatae vel longiores lineari-oblanceolatae, 1–4½ cm. longae, supra medium vel infra apicem obtusiusculum ad late rotundatum 1–2 mm. latae, basin acutissimam vel acumin-atam versus sensim angustatae, margine integerrimae vel hinc inde repandae; costa obscure viridis, in sicco fusca, prominens; venae valde obliquae, remotiusculae, simplices vel furcatae, ramulis ± aequilongis, marginem frondis non attingentibus. Sori costales, superficiales, in frondibus brevioribus solitarii et subterminales, in frondibus longioribus utrinque 1-seriatae, usque 10 utrinque, partem superiorem frondium occupantes, in juventute oblongi, maturi plus minusve rotundati, contigui; capsulae in juventute breviter ferrugineo-setulosae.

"Habit.: Mountain ridge near Doorman Summit, epiphytical in forest, alt. 1,420 m., H. J. Lam nos. 1549 (smaller specimens, with some of the fronds forked in the upper part), 1550 (larger specimens, with a single forked frond), 7 October 1920."

No. *1549* in Herb. Singap., *1550* in Herb. Univ. Calif., and both numbers in Herb. Lugd. Bat. I would call the paleae, about 1.5 mm long, lanceolate, and fuscous or castaneous, the dark stipes glabrescent, and the lamina herbaceous (it is translucent); that of *No. 1550* is about 3 cm long. The sori are basal on elongate veinlets.

FIG. 35

56b. POLYPODIUM VIRIDULUM v. A v. R.

Polypodium viridulum v. A. v. R., Nova Guinea **14** (1924) 41.

"*Eupolypodium, Integrifolia.*—Rhizoma breviter repens; squamulae erectae, lineari-lanceolatae, flavido-brunneae, accutae, integerrimae. Stipites ± 2½ mm. longi, glabri. Frondes firmiter herbaceae ad subcoriaceae, pallide virides, in sicco pallide olivaceo-brunneae, glabrae sed margine setulis brevissimis, patentissimis, ferrugineis, ± deciduis, remotiusculis ciliolatae, lineari-lanceolatae, 5–12½ cm. longae, medio 5–9 mm. latae, apicem obtusum vel obtusiusculum et basin acute cuneatam versus sensim angustatae, integerrimae vel subintegerrimae; costa praesertim basin versus obscure brunnea, in sicco pallide olivaceo-brunnea, basi fusca, subtus in juventute brevissime ferrugineo-setulosa, mox glabrescens; venae

remotiusculae, obliquae, marginem frondis non attingentes, steriles simplices, raro furcatae, fertiles furcatae, raro simplices, venulis ± aequilongis vel venula antica quam postica conspicue breviora. Sori utrinque 1-seriati, partem latiorem frondium occupantes, ad venulas anticas positi, remotiusculi, costam approximati, ± oblongi, leviter immersi, costae subparalleli; receptaculum oblongum vel lineari-oblongum; capsulae in juventute setulis brevissimis, ferrugineis copiose munitae.

"Habit.: Mountain ridge near Doorman Summit, epiphytical in forest, alt. 2,500 m., H. J. Lam n. 1853, 30 October 1920."

This is unknown to me. By the description, small specimens would seem not to be safely distinguishable from *G. oblanceolata.*

57. GRAMMITIS STANLEYANA (Baker) Copel., comb. nov.

Polypodium stanleyanum Baker, Jour. Bot. 28 (1890) 107.
P. trichocarpum v.A.v.R., Nova Guinea 14 (1924) 41.

"Rootstock not seen. Stipe naked, ½ in. long. Fronds linear, obtuse, entire, 3–5 in. long. ¼–⅓ in. broad, very thick and rigid in texture, glabrous and scaleless, narrowed gradually from the middle to the base. Veins quite hidden. Sori globose, superficial, medial between the midrib and edge, confined to the upper part of the frond.—Near the summit of the Owen Stanley range. Allied to *P. zeylanicum* Mett."—Baker, l. c.

"Rhizome rather thick, creeping, clothed with pale brown, broadly ovate, obtuse, entire, imbricated scales. The terete stipe short, at best 2 cm. long, glabrous; lamina entire, spathulate-oblong, 7–10 cm. long, 1 cm. wide just below the rounded obtuse apex long attenuate and cuneate at base, thickly coriaceous, dark above, brown beneath, both sides glabrous but the margins with some scattered atropurpureous short setae, which are sometimes forked with the branches parallel to the margin. Veins hidden, subpinnate; sori superficial, globose, uniserial at each side near the midrib; sporangia glabrous."—C. Chr., Brittonia 2 (1937) 304. Mt. Albert Edward, alt. 3680 m. *Brass 4258.*

Specimens: *Brass 4258,* subject of Christensen's note just quoted; *Clemens s. n.,* Morobe, Mt. Sarawaket, alt. 11,000 to 12,000 feet; *Lam 1693* and *1855,* isotypes of *P. trichocarpum* and its var. *inerme,* in Herb. Lugd. Bat. Mr. Alston cites, as in the British Museum, *Miss Cheeseman,* Mt. Tafa; *Kloss,* Carstenz Mts.; *Pulle 2482,* Watervalbiwak.

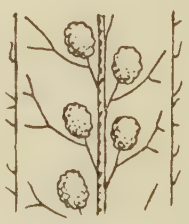

FIG. 36

Paleae ovate and up to 3 mm long on all except *Lam 1855,* on which they are lanceolate and up to 5 mm long, affixed above the base, present on all specimens on the base of the stipe as well as on the rhizome; veins twice to four times forked in the broader fronds, apparently only once in the Lam collections.

The sole difference between *G. stanleyana* and *P. trichocarpum* is that the latter has narrower fronds, in correlation with which its veins are less divided. The fronds are in all specimens obtuse or rounded. The sori are superficial or slightly impressed,—both conditions on Mrs. Clemens' plants. Unless it be on *Lam 1855,* which I cannot examine and which is perhaps too old, the sporangia of all bear dark bristles. Lam's plants were epiphytic; Brass', terrestrial; Mrs. Clemens does not say which. It is a relative of *G. fasciata,* commonly terrestrial, sometimes epiphytic.

58. **GRAMMITIS GRAMINIFOLIA Copel.**

G. graminifolia Copel., Univ. Calif. Cont. Bot. 18 (1942) 223.

G. G. fasciatae affinis, rhizomate brevi-repente, lignoso, 1.5–2 mm crasso, paleis brunneis integris nudis 3 mm longis 1 mm latis acutis imbricatis vestito; stipitibus 1–5 mm inter se distantibus, 1–2 cm longis, 0.7 mm crassis, atrofuscis, nudis; fronde erecta, 25 cm alta, 3 mm lata, acuta, decurrente, coriacea, glabra sed margine setulis ngiris appressis 0.5 mm longis sparsis munito; costa immersa sed utraque facie manifesta, filiforme, nigra; venis furcatis, sterilium ramis fere aequalibus hic illuc prope marginem anastomosantibus, omnino immersis; soris inframedialibus, superficialibus vel levissime impressis, venula fertile plerumque supra sorum protensa, sporangiis nudis.

FIG. 37

NEW GUINEA: Central Division, Mt. Tafa, alt. 2,400 m., tufted on scant soil on a landslip face." *L. J. Brass 5092,* of the First Archbold Expedition. Type in Herb. N. Y. Bot. Garden. Distributed as *Polypodium fasciatum f. angusta,* and published by Christensen, Brittonia 2 (1937) 304, as "a form with narrow fronds."

It is indeed near to *G. fasciata,* and represents that species in New Guinea. Aside from the remarkably narrow fronds, it is distinguished from the typical form of that species by the fine, appressed marginal bristles, and from all forms by the tendency to anastomosis of the veinlets. The once-forked veins are correlated with the narrowness of the frond; but, throughout the genus, anastomoses are to be expected where the lamina is most ample and the veins most branched. Where the bristles fall off, a brown spot remains.

Here belongs also *Brass 9111,* Lake Habbema camp, alt. 3,225 m, Dutch New Guinea, "in ground moss of an open

thicket," differing from the type only in having stipes 5 cm long, winged in the upper part by the long-decurrent lamina.

59. GRAMMITIS FRIGIDA (Ridley) Copel., comb. nov.

Polypodium frigidum Ridley, Trans. Linn. Soc. II Bot. 9 (1916) 259.

"Rhizoma 4 mm. crassum, squamis lanceolatis acuminatis pallide brunneis tectum. Frondes coriaceae, 17 cm. longae, integrae, glabrae, lineares, angustae, versus apicem et basin acuminatae, obtusae, 2 mm. longae, stipitibus distinctis gracilibus 4 cm. longis fugaciter furfuraceo-pubescentibus. Sori rotundato-elliptici, biseriati, in medio laminae siti (apice et basi frondis sterilibus), costa crassiuscula, nervis celatis.

"Camps XIII to XVI, 10,500 to 12,500 ft.

"Allied to *P. subselligueum* Baker, but much smaller and narrower, the blade distinctly separate from the pubescent stipes."—Ridley, l. c.

Coll. by Wollaston Exped., probably by Boden Kloss, in Dutch New Guinea.

With imperfect confidence, I refer to this species *Brass 11272* and *11267*, from 18 km NE. of Lake Habbema, alt. 2,200 m, epiphytic in mossy rain-forest on flood-banks of Bele River.

Rhizome wide-creeping, about 1 mm thick not including the paleae; paleae up to 6 mm long, 1.5 mm wide, obtuse, thin, stramineous to tawny, imbricate and mostly appressed; stipes 2.5 to 5 cm long, bearing inconspicuous light-brown hairs 0.6 mm long, finally glabrescent; lamina 15 to 19 cm long, 5 to 6 mm wide, attenuate to both ends, coriaceous, glabrous except for caducous marginal setulae; costa evident, veins invisible without clearing, widely divergent, commonly twice forked (sometimes once); sorus terminal on a rather long veinlet, inframedial to medial, superficial or nearly so, roundish-oblong; *Brass 10279* is probably the same species, but has a frond 10 mm wide, some of the veinlets again forked, and some of the fertile veinlets prolonged above the sorus.

FIG. 38

60. GRAMMITIS SUBFASCIATA (Ros.) Copel., comb. nov.

Polypodium subfasciatum Ros., Fedde's Repert. 5 (1908) 41.

"*Grammitis*: rhizomate breviter repente, curvato, circiter 2 mm crasso, paleis pallide rufescentibus, angustato-lanceolatis, c. 5 mm longis, integerrimis, nitentibus onusto; stipitibus 0–2 cm longis, stramineis, glabris, laminis coriaceis, glabris, supra saturate viridibus, subtus pallidioribus, usque ad 25 cm longis, 12 mm latis, lineari-lanceolatis, versus basin longe attenuatis, integerrimis, margine angusto, attenuato, deorsum reflexo, nervo mediano parenchymate obtecto, supra planiusculo, subtus prominente; nervis lateralibus inmmersis, submanifestis, 1–2–ies furcati vel subpinnatis, ramis basalibus usque fere ad marginem productis, anticis ad basin soriferis; soris superiorem partem laminae occupantibus,

utrinque uniseriatis, nervo mediano approximatis, subrotundis, subimmersis; sporangiis setiferis.

"Nova Guinea: in monte Gelu, prope "stationem," c. 1000 m alt.—leg. Dr. E. Werner, VII, 1907, No. 25.

"*Polypodium fasciatum* Mett. unterscheidet sich durch breitere Rhizomchuppen, schmäleres Blatt und nackte Kapseln, *P. dolichosorum* Copel. durch behaarten Blattstiel, stärker verlängerte Sori und ebenfalls durch nackte Kapseln."—Rosenstick, l. c.

Isotype in Herb. Univ. Calif. The description is accurate except for misprint as to the paleae, which are 5 mm (not 0.5 mm) long. A smaller plant correctly identified by van Alderwerelt van Rorenburgh as this species is *Lam 1968,* from the trail to Doormantop, alt. 2,500 m, in Hort, Lugd. Bat. Its largest fronds are 15 cm by 8 mm; and very few veins are more than once forked, as would be expected in smaller fronds. The veins fall short of the margin, and their tips are marked by hydathodes. The distinctly elongate receptacles are borne above the bases of the fertile veinlets, and the latter may or may not be prolonged a little beyond the sori.

FIG. 39

61. GRAMMITIS INTEGRA (Brause) Copel., comb. nov.

Polypodium integrum Brause, Engl. Jahrb. 49 (1912) 37.

"Eupolypodium. Rhizoma repens, 3–4 mm crassum, paleis griseo-fuscis; peltatis, e basi cordata, usque ad 1 mm lata elongato-triangularibus, acuminatis, integris, 4 mm longis, squarrosis vestitum, folia densa, petiolata emittens. Petioli fusci, ca. 3 cm longi, angustissime alati, cr. 1.3 mm crassi, supra sulcati, infra teretes, glabri. Laminae 32 cm et ultra longae, usque ad 1.8 cm latae, ambitu lineari-lanceolatae, ad basin versus longe angustatae, glabrescentes, juventute margine pilis brevibus brunneis sparsis praeditae, coriaceae, integrae, margine anguste revolutae; nervis vix conspicuis, pinnatis. Sori uniseriales in utroque mediani nervi latere, ramo antico infimo dorsales impositi, usque ad 44-jugi, 3–4 mm distantes, superiorem laminae partem occupantes.

"Nordöstl. Neu-Guinea: Kaiser-Wilhelmsland, Lager "Hochmoos," 65 km südwärts der Tami-Mündung, 1200 m. ü. M. (L. Schultze n. (26) 21.—Juli 1910).

"Steht *P. fasciatum* (Bl.) Pr. nahe, dieses ist aber küzer und schmäler, die Nerven sind nur gegabelt, nicht gefiedert, die Rhizomschuppen sind anders."—Brause, l. c.

Without an authentic specimen, I construe this by the description and by a photograph, in U. S. Nat. Herb., of the type, and so identify *Brass 9358,* from Lake Habbema camp, alt. 3,225 m, Third Archbold Expedition, Dutch New Guinea, "Terrestrial or epiphytic in forest moss."

The rhizome is stout and creeping, but the fragment in hand is without good paleae; stipes 4 to 8 cm long, 1 mm in diameter or slightly stouter, the upper part winged by the long-decurrent base of the lamina; lamina 30 to 34 cm long, 9 to 11 mm wide, attenuate to both ends, glabrous, coriaceous, margin deflexed; veins mostly twice forked, both branches approaching the margin, ending under black dots; sori above the bases of the fertile veinlets, costal, orbicular or nearly so at maturity, superficial; sporangia naked at and somewhat before maturity.

This deviates from the description by being narrower, and accordingly with less-divided veins. I find no marginal setulae; but there are some black dots such as often mark places where setulae have been.

Mr. Alston regards this as the same as *G. subfasciata;* and he may well be correct; but I feel hardly justified, by the scanty known material, in combining them.

62. **GRAMMITIS PLEUROGRAMMOIDES (Ros.) Copel.**

Grammitis pleurogrammoides (Ros.) Copel., Genera Filicum (1947) 213.

Polypodium pleurogrammoides Ros., Fedde's Repert. **5** (1908) 42; Copel., Univ. Calif. Publ. Bot. **12** (1931) 402.

"*Grammitis;* rhizomate adscendente, ramoso, paleis fulvidis, peltatim affixis, ovali-lanceolatis, obtusiusculis, 4–5 mm longis, 0.75 mm latis, leviter appressis obtecto, versus apicem frondes laxe dispositas vel subfasciculatas gerente; stipitibus vix 0.5 cm longis, atropurpureis, caudici appressis; laminis e basi angustato-cuneato lineari-ligulatis, c. 5 cm longis, 6–7 mm latis, margine leviter repando-crenatis, coriaceis, supra glaberrimis, subtus, imprimis prope marginem, sparsim pilis subulatis, furcatis stellatisve, atropurpureis, deciduis, ad incisuras singulis crassioribus, simplicibus, incurvis instructis; costa mediana viridula, utrinque prominula, in parte tertia suprema evanescente; nervis lateralibus immersis, furcatis, ad basin rami antici soriferis; soris areolis obliquis immersis, costae approximatis, sporangiis seta geminata subulata, atropurpurea, robusta armatis.

"Nova Guinea: in summo montis Gelu, c. 1700 m alt.—leg. Dr. E. Werner, VI, 1907, No. 22.

"Die Art kommt dem *Polypodium Jagorianum* Mett. am nächsten, das jedoch beiderseits stark behaart ist und dessen Kapseln eine einfache Borste tragen. *P. australe* Mett. und *P. subevenosum* Baker (*P. sessilifolium* Hook.) besitzen beide unbewehrte Kapseln, letzteres ausserdem dünnere Textur und ungegabelte Nerven. *Polypodium locellatum* Bak. mit gleichen Sori und ebenfalls aus Neu-Guinea stammend, ist durch langgestieltes und grösseres Blatt völlig verschieden."—Rosenstock, l. c.

Known only by the original collection, of which an isotype is in Herb. Univ. Calif. The ascending slender rhizome is several centimeters long; paleae persistent, firm bearing 1 to 3 caducous filamentous tails at the tip; apex of frond round, margin entire to crenate-sinuate, marginal bristles mostly solitary; costa immersed, but costal area apparently broad and elevated because of the narrowly separated and deeply immersed sori, which are elliptic and effectively parallel to the costa; veins once forked, the basiscopic veinlet prolonged and curved, rarely again forked near the apex, fertile veinlet usually prolonged beyond the sorus, and almost invisible, probably because without any sheath of sclerenchyma,—cf. Christensen, Dansk bot. Arkiv **6** (1929) 31.

FIG. 40

Clemens 40991, 40992 partim, 41016, all from Morobe, alt. 5,000 to 6,000 feet; also *Brass 12734,* Idenburg River region, alt. 1,600 m. The material is old and the marginal setae very nearly absent; the paleae somewhat shorter and broader, and now without tails, as are most of those of the type collection.

There is no character by which this species can be separated from *Grammitis.* However, its affinity to *Scleroglossum,* which I have already discussed, is manifest. As a genus, *Scleroglossum* should be distinguished by producing coenosori.

63. GRAMMITIS INTERRUPTA (Baker) Copel.

Grammitis interrupta (Baker) Copel., Genera Filicum (1947) 214.
Monogramme interrupta Baker, Annals Bot. 5 (1891) 482.
Pleurogramme interrupta Christ, Farnkr. d. Erde (1897) 55.
Nematopteris interrupta C. Chr., Dansk bot. Arkiv **6** (1929) 31, *pl. l. 4, fig. 8–12.*
Polypodium pyxidiforme v.A.v.R., Bull. Jard. Buit. II **1** (1911) 29; Nova Guinea **14** (1924) 44, *pl. 1C.*

"Stipes densely tufted, wiry, naked, 2–3 in. long. Frond linear, thick, rigidly coriaceous, glabrous, 1–1⅓ in. long ½₂ in. broad. Veins quite hidden. Sori filing the whole space between the midrib and margin, which is broken up into a series of pits of unequal length, in which the sporangia are immersed. New Guinea; Mt. Yule."—Baker, l. c.

This is known to me by *Lam 1051,* the type collection of *P. pyxidiforme,* and *1965,* in Herb. Lugd. Bat.; *Brass 11863* and *12603,* Idenburg River, alt. 1,800 and 2,150 m. I take the synonymy from Christensen (*Nematopteris*). Because it produces simple sori, not coenosori, I include it in *Grammitis*

FIG. 41

instead of in *Nematopteris,* to which, as Christensen said, "It is scarcely closely related." The affinity to *G. pleurogrammoides* is evident and close. In its difference from the latter, it presents yet one addition to the score or more of parallel evolutions by which the spore production of a frond is restricted to the apex, and raised as far as possible into air dry enough to permit dissemination of the spores.

Van Alderwerelt's description is good, and is perfected by Christensen's description and illustrations. One correction must be made: Stipes and fronds are glabrescent, not glabrous. This is evident on the Brass collections, and I then find it so of *Lam 1965.* The deciduous pubescence is exceedingly minute, but not sparse.

64. GRAMMITIS PLURISETULOSA Copel.

Grammitis plurisetulosa Copel., Univ. Calif. Publ. Bot. **18** (1942) 223.

G. rhizomate lete repente, cum paleis 6 mm., sine paleis 1.5 mm crasso; paleis laete stramineis, 5 mm longis, 1.5 mm latis, acutis, supra basin affixis, densissime imbricatis persistentibus; stipitibus inter se 1–5 mm remotis, 5–6 cm altis, 0.5–0.7 mm crassis, brunneis, glabris; lamina usque ad 10 cm alta et 5 mm lata, utrinque attenuata, glabra, coriacea, costa utraque facie inconspicua vel superne impressa nigra; venis furcatis, venulis fere ad marginem protensis; soro supra basin et infra apicem venulae fertilis, inter costam et marginem mediale, receptaculo obliquo oblongo, soro etiam plus minus oblongo, insigniter impresso, sporangiis setulis brevibus curvis atris pluribus (usque ad 6) persistentibus ornatis, annulo 12-cellulare.

FIG. 42

DUTCH NEW GUINEA: Mt. Wilhelmina, *Brass* and *Myer-Drees 10109,* type, "Alpine grassland; massed on sheltered sides of mossy rocks, 3,950 m alt." Also, Nos. *10037* and *10308,* alt. 3,800 m, on mossy trees of subalpine forest; *10108,* tufted on rock, alt. 4,240 m; *9631, 9858, 9899,* alt. 3,560 m, epiphytic and on rocks. Here belong also all but one frond of *"Keyser II 33* and *34,"* from Mt. Bolan, alt. 3,400 to 3,800 m, and *Clemens s. n.,* from Mt. Sarawaket, alt. 11,000 to 12,000 feet. Here also *Brass 4257,* "Polypodium caespitosum (Bl.) Mett., var.?" of Christensen, Brittonia 2 (1937) 303, from Mt. Albert Edward, alt. 3,680 m.

The Keysser specimen was received by Herb. Univ. Calif. as "Pol. locellatum Bak. det. Rosenstock ex descr.," and con-

tains one loose frond which I interpret as that species. Mrs. Clemens has sent me both species from Mt. Sarawaket, but as separate collections. They are not subject to confusion, as the sori of *G. plurisetulosa* are in depressions open from the start, while those of *G. locellata,* as I interpret it, are in slits, closed until near maturity. *G. loculosa* has the sori in pits like those of *G. plurisetulosa,* but stipes less than 1 cm long. The species to which *G. plurisetulosa* is very near is *G. caricifolia,* which is smaller, and with the sori slightly or not all impressed, and with fewer and deciduous setulae on the sporangia.

65. GRAMMITIS LOCULOSA (v.A.v.R.) Copel.

Grammitis loculosa (v.A.v.R.) Copel., Univ. Calif. Publ. Bot. **18** (1942) 223.

Polypodium loculosum v.A.v.R., Nova Guinea **14** (1924) 42.

"*Eupolypodium, Integrifolia.*—Rhizoma breve; squamulae erectae, lineari-lanceolatae, flavido-brunneae, acutae, integerrimae. Stipites approximati, ½–1½ cm. longi, in juventute copiose, brevissime ferrugineo-puberuli, glabrescentes. Frondes coriaceae, subpellucidae, glabrae sed margine setulis brevissimis, remotis, patentissimis, rubrobrunneis parce ciliolatae, lineari-lanceolatae, 6–18 cm. longae, in media parte 3–5 mm latae, apicem obtusiusculum et basin acute cuneatam versus sensim angustatae; costa subtus prominens, in juventute parce, brevissime, decidue rubro-brunneo-setulosa, glabrescens; venae obliquae, remotiusculae, furcatae, venulis ± aequilongis, marginem frondis non attingentibus. Sori utrinque 1-seriati, inter costam marginemque mediani, in foveis profundiusculis, saepe breviter oblongis et costae parallelis vel subparallelis, supra prominentibus, breviter subconoideis immersi, ad venulas anticas positi, partes angustatas superiores inferioresque frondium negligentes; receptaculum oblongum, obliquum (foveae non parallelum); capsulae in juventute probabiliter parce, breviter castaneo-setulosae.

"Habit.: near Doorman River, epiphytical in forest, alt. 200 m., H. J. Lam n. 1267, 21 Sept. 1920."

Known to me only by the original collection, isotype in Herb. Ludg. Bat. Paleae 3 mm long, lanceolate; stipes loosely fascicled, dark-fuscous; veins forked at some distance from the costa, the branches widely divaricate, the sori at or above the middle of the fertile veinlets. Some dark setulae can be found on the sporangia. Mr. Alston refers here *Copeland King S 8,* from Aikora.

FIG. 43

66. GRAMMITIS DICTYMIOIDES Copel.

Grammitis dictymioides Copel., Univ. Calif. Publ. Bot. **18** (1924) 223.

G. rhizomate breve, adscendente, crasso, paleis ferrugineis ovatis acuminatis 3–4 mm longis membranaceis vestito; stipitibus approximatis, 1–2 cm longis, 1 mm crassis, nudis, nig-

rescentibus; lamina 30–40 cm longa, 7–10 mm lata, acuta, deorsum attenuata, integra, glabra, coriacea, costa inferne prominente; venis furcatis, venula basiscopica latere exteriore ramulifera, acroscopica infra et ultra sorum elongata, plerumque cum apice venulae sterilis ipsius venae, rarius venae sequentis anastomosante; soris uniserialibus, inframedialibus, oblongis, costae fere parallelis, profunde immersis, crateris setis cinnamomeis protectis, sporangiis setulis persistentibus plerisque curvatis munitis.

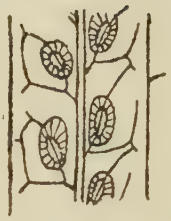

FIG. 44

DUTCH NEW GUINEA: Lake Habbema, alt. 3,225 m, *Brass 11848,* rare epiphyte in subalpine forest; *ibid., No. 9375;* also, *No. 9059,* "mossy thickets of peat ridges. Epiphyte on upper parts of low trees; fronds bluish,"—this specimen dwarfed, fronds 15 cm long, 5 mm wide, very thick and rigid.

A relative of *G. loculosa,* which has marginal setulae and no hairs protecting the soral craters. From this and all other species, *G. dictymioides* is distinguished by its venation, which might technically exclude it from the genus. It does not, however, reach nearly the degree of reticulation of *Dictymia.* At the narrowing apex and base, the veins are free; and in the broader part of the frond, occasional free fertile veinlets interrupt the series of areolae.

The resemblance is not so much to *Dictymia* as to *Anarthropteris,* which was not distinguished from *Dictymia* when this species was named. There is no near affinity to either. *G. dictymioides* is superficially so like *Paragramma longifolia* (*Grammitis longifolia* Blume) that they might not be distinguished at first glance.

67. GRAMMITIS LOCELLATA (Baker) Copel.

Grammitis locellata (Baker) Copel., Univ. Calif. Publ. Bot. 18 (1942) 223.

Polypodium locellatum Baker, Jour. Bot. 28 (1890) 108.

"Rrizome short-creeping, ⅛ in. thick, densely clothed with small ovate-lanceolate pale-brown paleae. Stipes slender, naked, wiry, erect, 2–3 in. long. Fronds simple, linear, entire, glabrous, thick, rigid, 5–6 in. long, ⅛ in. broad at the middle, narrowed gradually to the base and apex. Veins hidden. Sori oblong, oblique, immersed in deep pits, forming a long row nearer the midrib than the margin.—Mount Victoria. Very distinct in *Polypodium,* section *Grammitis,* by its deeply immersed sori."—Baker, l. c.

I have not seen an original specimen, but feel confident that this species is represented by a collection by Mrs. Clemens,

Morobe District, Mt. Sarawaket, alt. 11,000 to 12,000 feet, May, 1939.

Rhizome creeping, stout (2–3 mm in diameter, 5 mm including paleae), paleae narrowly ovate, fuscous, 1.5 mm long; stipes 6 to 11 cm long, 0.4 mm thick, wiry, glabrescent, fuscous; lamina up to 14 cm long and 8 mm wide, attenuate upward, long-cuneate at base, coriaceous, naked; veins mostly twice forked, occasionally anastomosing; sori inframedial on the half-lamina, medial on the elongate fertile veinlets, long-oblong, oblique, deeply immersed; sporangia bearing dark bristles.

FIG. 45

The Keysser collection purporting to be *G. locellata,* but almost wholly *G. plurisetulosa* as received by Herb. Univ. Calif., has been mentioned under the latter name.

68. GRAMMITIS STOMATOCARPA Copel.

Grammitis stomatocarpa Copel., Univ. Calif. Publ. Bot. 18 (1942) 223.

Rhizomate breve, adscendente, paleis ferrugineis lanceolatis, ca. 3 mm longis occulto; stipitibus approximatis 7–16 cm longis, filiformibus, rigidulis, fuscis, pilis pallidis perdebilibus usque ad 1 mm longis haud dense vestitis; lamina quam stipite breviore, lanceolata, apice acuminata, basi brevi-decurrente, integra, coriacea, glabra, brunnea; venis immersis et inconspicuis, bis furcatis, venulis ad marginem fere attingentibus; soris oblique positis, valde elongatis, profunde immersis, sporangiis setulis castaneis plerisque curvis deciduis minutis.

FIG. 46

DUTCH NEW GUINEA; 7 km northeast of Wilhelmina-top, in subalpine forest, alt. 3,650 m, *Brass 9858 A,* type; *ibid.,* No. *9630*; Lake Habbema, alt. 3,225 m, No. *9215.*

A relative of *G. stenocrypta,* distinguished by longer stipes, shorter fronds, and much longer sori. The largest frond is 14 cm long by 13 mm broad, the sori 8 mm long. A commoner size seems to be 6 cm by 6 mm; and some are still smaller. Without seeing the veins, invisible without preparation, one might misplace this because of the very long sori, completely immersed and enclosed until about mature; but I have been unable to locate a description under any generic name. Its local relative is *G. locellata,* which has smaller and

darker paleae, naked stipe, shorter sori, and less setulose sporangia. Mr. Alston regards them as one species, which may be correct; but until future collections may close the gap between them, they seem distinct to me.

69. GRAMMITIS SCABRISTIPES (Baker) Copel.

Grammitis scabristipes (Baker) Copel., Univ. Calif. Publ. Bot. 18 (1942) 223.

Polypodium scabristipes Baker, Jour. Bot. 28 (1890) 108.

"Rootstock not seen. Stipe brown, wiry, scabrous, 2–3 in. long. Frond simple, linear, entire, 5–6 in. long, ⅛ in. broad at the middle, thick, rigid, nearly glabrous, narrowed to the base. Veins forked, erecto-patent. Sori oblong, oblique, rather immersed, 1/12 in. long, placed in a row nearer the midrib than the edge.—Near the summit of the Owen Stanley range. Near the Malayan *P. fasciatum* Mett."—Baker, l. c.

"Stipe to 10 cm. long, with spreading brown hairs 2–5 mm. long, which are seated on prickles, the stipe thus asperous. Lamina 20 cm. by 8–9 mm., lanceolate, narrowed toward both ends, coriaceous, glabrous above with a marginal row of calcareous dots, the lower side and margins with many long reddish hairs. Veins hidden, at least forked. Sori uniserial, costular, oblong, oblique, not confluent, somewhat immersed, when young covered with long hairs, when old grayish white with a secretion of a calcareous substance. Sporangia armed with some stiff brown setae."—C. Chr., Brittonia 2 (1937) 305. Mt. Tafa, alt. 2,400 m. *Brass 5094.*

Specimens: *Brass 5094,* subject of Christensen's note just quoted: *Clemens s. n.,* two collections, Morobe, Mt. Sarawaket, alt. 9,000 to 12,000 feet; *Brass 9102, 9676, 9849,* Mt. Wilhelmina region, Dutch New Guinea, alt. 3,225 to 3,560 m. *Brass 11432* is also referred here, but the paleae are smaller and darker. Mr. Alston cites also *Gibbs 5972,* Angi Lake.

Paleae bright-brown, lanceolate, 3 mm long; veins all forked twice, and mostly oftener, all veinlets ending in hydathodes, which bear a lime deposit in the Brass but not in the Clemens collections, casual anastomoses not rare, fertile veinlet usually prolonged; sorus elongate, slightly immersed or superficial, sporangia freely setulose with long setae, sometimes geminate, which darken, and then disappear.

FIG. 47

More like the Malayan *G. limapes* than the Luzon *G. bulbotricha,* distinguished from the former by narrower and longer paleae, longer hairs on the stipe, lamina decidedly more setose beneath, and smaller sori nearer to the costa.

70. GRAMMITIS NOVOGUINEENSIS Copel.

Grammitis novoguineensis Copel., Univ. Calif. Publ. Bot. 18 (1942) 223.

Polypodium diplosorum f. *grammitoides* Ros.

G. rhizomate brevirepente, 2 mm crasso, paleis ferrugineis ovatis 2–3 mm longis vestito; stipitibus approximatis, 2–7 cm altis, 1 mm crassis, setis 2–2½ mm longis castaneis basibus magnis conicis vestitis et deinde (pilis dejectis) horridis; fronde 20–25 cm alta, 11–14 mm lata, utrinque angustata, integra vel subundulata, coriacea, superne vetustate glabra inferne proximitate sororum excepta glabrescente, veins immersis non occultis, 3–4 furcatis; soris magnis, irregulariter biseriatis, seriei primae costalibus 2–7 mm longis 1.7 mm latis divergentibus setis paucis longis circumdatis et mixtis, seriei alterae irregularis oblongis 2–3 mm longis, sporangiis sparse setuliferis.

FIG. 48

NEW GUINEA: Bolan, alt. 3,400 to 3,800 m, *Bamber* No. *B 41*. Type in Herb. Univ. Calif. No. *391432*. *Keyser* No. *B 1*, from the same place, *P. diplosorum* var. *projectum* Ros. in herb., seems to be a monstrous form of this species, with irregular, pinna-like lateral outgrowths 3 mm wide, and even 4 cm long.

This is no near relative of *P. diplosorum*, but a member of a small, compact group consisting, so far as known, of *G. scabristipes*, *G. bulbotricha* of Luzon, and *G. limapes* of Java. As to *G. scabristipes* and *G. limapes*, I confess that I overlooked the former in describing the latter, and by Baker's description cannot distinguish them. Christensen's more detailed description of *G. scabristipes*, Brittonia 2 (1937) 305, seems to make *G. limapes* distinguishable by shorter hairs on the stipe and more naked fronds. *G. novoguineensis* seems to be distinguished by the long sori, imperfect second row, several times forked veins, and broader fronds, besides the really superficial sori. However, all but the last are correlated features, and might merely characterize a more luxuriant development.

71. GRAMMITIS COREDROSORA (v. A. v. R.) Copel., comb. nov.

Polypodium coredrosorum v.A.v.R., Nova Guinea 14 (1924) 44.

"*Eupolypodium, Integrifolia.*—Rhizoma breve, indistinctum, pilosum. Stipites fasciculati, ½–1½ cm. longi, filiformes, pilis gracilibus, longiusculis, squarrosis, albidis vel pallide rufis copiose muniti. Frondes pellucido-subcoriaceae, utrinque pilis pallide rufis vel rubro-brunneis, longioribus et ± deciduis (fragilibus) brevioribus et ± persistentibus copiose munitae, lineari-oblanceolatae, 1½–6 cm. longae, 2–3 mm. latae, supra medium

latissimae, apicem obtusum vel obtusiusculum et basin cuneatam vel acuminatam versus sensim angustatae; venae obliquae, remotiusculae, simplicibus vel saepius furcatae, marginem frondis non vel vix attingentes; venulae venularum furcatarum ± aequilongae. Sori partem superiorem frondium occupantes, utrinque 1-seriati, costam quam marginem magis approximati, rotundi, majusculi, superficiales, maturi ± contigui et costam tangentes; receptaculum suboblongum; capsulae graciliter, longissime stipitatae, in juventute copiose, longiuscule pilosae, pilis iis frondium similibus.

"Habit.: Mountain ridge near Doorman Summit, epiphytical in forest, alt. 1420 m., H. J. Lam n. 1550a, 7 October 1920."

Known to me by isotype in Herb. Lugd. Bat., 4 individuals. There are vestigial paleae concealed by the hairy stipe-bases, ca. 0.5 mm long, ovate, yellowish-brown, not hairy; stipes 0.4 to 0.6 mm long; lamina 4 to 6 cm by 2 to 3 mm, the numerous hairs 0.3 to 0.4 mm long; sori near the bases of the fertile veinlets, about medial or slightly inframedial. Similar to *G. parva*, but with long fronds and distinctly shorter hairs.

FIG. 49

These do not seem to be juvenile plants. If they are not, this is a reduced species, like the American *G. yarumalensis* and (so far as it is known) *G. Sprucei*,—like these in the weak development of rhizome and paleae, as well as in the small size.

72. **GRAMMITIS PARVA** (Brause) Copel.

G. parva (Brause) Copel., Genera Filicum (1947) 211.
Polypodium parvum Brause, Engl. Jahrb. **49** (1912) 36.

"Grammitis. Rhizoma breve, adscendente. Petioli fasciculati, filiformes, pilis fuscis, recte patentibus, muniti, usque ad 1 cm longi. Laminae membranaceae, pellucidae, lineari-lanceolatae, apice rotundato-obtusiusculae, integrae vel margine leviter undulatae, utrinque pilis longis fuscis instructae, maximae 3.1 cm longae, 2 mm latae; nervis medianis plerumque geniculatis, nervis lateralibus simplicibus vel furcatis, laminae marginem non attingentibus, Sori rotundi, ramo antico impositi, mediani, superiorem dimidiam laminae partem occupantes, 1–5–jugi. (Fig. 2 C.)

"Nordöstl. Neu-Guinea: Kaiser-Wilhelmsland, in den Wäldern des Finisterre-Gebirges, 1000 m u. M. (Schlechter n. 18033.—17. Juli 1908).—ad Baumstämmen in den Wäldern des Kani-Gebirges, cr. 1000 m u. M. (Schlechter n. 17156.—7 Jan. 1908)."—Brause, l. c. Mr. Alston refers here *Carr 18525*, from Boridi.

Both originally cited numbers are in Herb. Univ. Calif. No paleae evident; stipes blackish; lamina 2 to 2.5 mm broad, bearing hairs up to 2 mm long; sporangia bearing pale setae longer than their diameter. These plants look juvenile, with their almost undeveloped rhizomes, no visible paleae, and few mem-

FIG. 50

branaceous fronds; but they are in full enough friut. This species and *G. coredrosora* are remarkably alike; but this is the result of convergent reduction, and they may not be near relatives. If they were sterile, they would be regarded as sporelings of very distinct species. The difference is in the pubescence, very short, and dense, on *G. coredrosora,* remarkably long in proportion to the size of the frond, on *G. parva.*

73. GRAMMITIS MESOCARPA (v. A. v. R.) Copel., comb. nov.

Polypodium mesocarpum v.A.v.R., Nova Guinea **14** (1924) 42.

"*Eupolypodium, Integrifolia.*—Rhizoma breve; squamulae anguste linearilanceolatae, pallide ferrugineae, acutae, integerrimae. Stipites aggregati, 0–5 mm. longi, pilis squarrosis, longiusculis, rubro-brunneis, plus minusve deciduis muniti. Frondes coriaceae, supra obscure virides, in sicco fuscae, praesertim ad et prope marginem pilis castaneis, setuliformibus, sparsis, plus minusve deciduis ornatae, subtus pallidiores, glabrae (glabrescentes?), lineari-lanceolatae, 6–18 cm. longae, 3–5 mm. latae, basin acute cuneatam et apicem longe, obtusiuscule acuminatum, rectum, leviter curvatum vel subflexuosum versus sensim angustatae, integerrimae; costa obscure viridis, in sicco fusca, utrinque breviter castaneo-setulosa, subtus prominens; venae numerosae, subcompactae, conspicue adscendentes, immersae sed contra lucem conspectae distinctae, prope basin furcatae, venulis longis, marginem frondis attingentibus. Sori 6–26 utrinque, rotundati, specie costales (ad basin venularum anticarum positi), contigui, vix immersi; receptaculum suboblongum; capsulae copiose castaneo-setulosae.

"Habit.: Mountain ridge near Doorman Summit, epiphytical in swampy forest, alt. 1,420–1,450 m., H. J. Lam nos. 1487, 1878, 4 October and 2 November 1920."

I have seen no authentic specimen, but *Brass 12009,* Idenburg River region, alt. 1,800 m., epiphytic in mossy forest, conforms approximately to the description.

Paleae 3 mm long, lanceolate, acute to acuminate, bright-brown; stipes very short, their hairs 0.3 to 0.6 mm long, dark, deciduous; lamina 10 to 12 cm by 5 to 6 mm, coriacous but easily cleared, bearing sparse short deciduous setulae on both surfaces; veins forked, both branches elongate almost to the margin; sori basal on the acroscopic branches, inframedial but confluent and extending to or over the costa, somewhat impressed; sporangia as described.

FIG. 51

Short stipes, common farther west, are unusual in New Guinea. *G. adspersa* (as *Polypodium malaicum*) is reported from New Guinea by Rosenstock, Nova Guinea 8 (1912) 725,—*v. Roemer 1168,* Hellwig-Gebirge.

74. GRAMMITIS SUMATRANA (Baker) Copel.

Grammitis sumatrana (Baker) Copel., Philip. Jour. Sci. **56** (1935) 97.

Polypodium sumatranum Baker, Jour. Bot. 18 (1880) 214; v.A.v.R., Bull. Dept. Agr. N. I. No. 18 (1908) 19; Copel., Philip. Jour. Sci. 40 (1929) 309.

P. subpleiosorum Racib., Pterid. Buitenzorg (1898) 89.

P. pleiosoroides Copel., Perkins' Fragmenta (1905) 189.

P. serraeforme Brause, Engl. Jahrb. 49 (1912) 36, *non* J. Sm.

P. brauseanum v.A.v.R., Malayan Ferns Suppl. (1917) 521, a substitute for the preceding name.

P. biseriale Ridley, Linn. Soc. Trans. Bot. 11 9 (1916) 260 *non* Baker.

"Rhizome short-creeping, epigaceous, ⅛ in. diam. Scales densely imbricated, pale brown, lanceolate. Stipes contiguous, very short, wiry, erect, covered with minute brown pubescence. Fronds ligulate, 6–12 in. long, ⅝–¾ in. broad at the middle, subcoriaceous, glabrous, narrowed gradually to both ends, the edge furnished with broad shallow rounded lobes. Veins in a pinnate group opposite each lobe, the veinlets about three on a side, short, erecto-patent, arranged like those of *Goniopteris*, but not joining at the tips. Sori copious, orbicular, superficial, placed a little below the tip of the side veinlets, so that there are several irregular rows between the midrib and edge. Mt. Singalan, 1700 meters. An interesting novelty, nearly allied only to the Andine *P. trichosorum*, Hook."—Baker, l. c.

Paleae 3 mm long, lanceolate to ovate; stipes up to 6 cm long (*Copeland s. n.*, Mt. Matutum), but usually short, the dense pale pubescence about 0.4 mm long; fronds subcoriaceous or coriaceous. Costa and margin bear sparse, minute, dark setulae, those on the margin sometimes binate or clustered. Some sporangia bear short dark setulae.

FIG. 52

I have seen no Sumatra specimen, but have in hand the type collections of *Polypodium subpleiosorum, P. pleiosoroides* and *P. serraeforme* Brause, which are indistinguishable. *P. biseriale* is reduced by description. Ridley says: "From *P. pleiosoroides*, Copeland, of the Philippines, it differs in having pubescent stipes, and undulate margin";—impossible as a distinction, since *P. pleiosoroides* has pubescent stipes and the margin was described as sinuate. The margin is entire on some small fronds, and varies through broadly crenate to quite irregular.

JAVA: *Raciborski*, type collection of *P. subpleiosorum*, in Philip. Nat. Herb. *Swartz 2740, Lörzing 1799b.* BORNEO: *Clemens 10920 partim, 33743, 50911, Holttum 25503.* MINDANAO: *Copeland 1101*, type of *P. pleiosoroides*, and single plants of 28 years later. NEGROS: *Elmer 10003.* NEW GUINEA: Schlech-

ter 18142, type collection of *P. serraeforme* Brause, in Herb. Univ. Calif.

Wide-spread, but apparently not common, since it is fairly conspicuous but seldom collected.

75. GRAMMITIS SUBREPANDA (Brause) Copel; comb. nov.

Polypodium subrepandum Brause, Engl. Jahrb. **49** (1912) 37.

"Eupolypodium. Rhizoma breve, erectum, paleis pallidis elongato-triangularibus, acuminatis, integris, densis vestitum. Folia fasciculata, petiolata. Petioli teretes, usque ad 5.5 cm longi, 0.8 mm crassi, pilis brevibus, recte patentibus vel declinatis, densis armati. Laminae coriaceae, siccae supra brunneae, infra pallidiores, e basi longe angustata lineari-lanceolatae, in apicem obtusiusculum acuminatae, usque ad 23 cm longae; 1.2 cm latae, margine repandae vel leviter crenatae, utrinque glabrae; nervis vix conspicuis, subpinnatis, flexuosis. Sori numerosi bivel triseriales in utroque mediani nervi latere, series prima et tertia ramis anticis, series secunda ramo postico impositae, paulum immersi.

"Nordöstl. Neu-Guinea: Kaiser-Wilhelmsland, Lager, 'Hochmoos,' 65 km. südwärts der Tami-Mündung, 1200 m. ü. M. 16.—Juli 1910).

"Nähert sich der *P. trifurcatum*-Gruppe mit seinen gefiederten Nerven, hat aber mit keiner anderen der bisher bekannten Arten besondere Aehnlichkeit."—Brause, l. c.

Werner 19 in Herb. Univ. Calif., believed to be correctly named, deviates from the description: The rhizome is short-creeping, the stipes approximate but not fasciculate (photograph of the type, in U. S. Nat. Herb. shows this also); and there are sparse setulae on costa and margin. I have ample and varied material of this species, collected by Brass in Dutch New Guinea:—No. *12884,* Idenburg River region, alt. 1,200 m, stipe 2 to 2.5 cm, lamina 13 to 18 cm long, entire to obscurely crenate; No. *12215,* same region, alt. 1,800 m, stipes about 4 cm and lamina about 15 cm long, entire to crenate; No. *10630,* Lake Habbema region, alt. 2,800 m, and *11241,* alt 2,200 m, stipes 4 to 7 m, fronds about 15 cm long, subentire to crenate-lobed; Nos. *11599,* alt. 2,200 m, and *10820,* alt. 2,800 m., Lake Habbema region, 6 to 8 cm, lamina 15 to 18 cm long, and No. *9266,* stipes 7 to 11 cm, lamina 23 cm long, crenate-lobed. Rhizomes creeping, paleae stramineous to brown, lanceolate to ovate; stipes fuscous, fusco-velutinous; margin and young costae (beneath) sparsely short-setulose; main veins

FIG. 53

usually conspicuous, veinlets concealed, 5 or 6 on a side in large fronds, rarely confluent in the manner of *Goniopteris,* prolonged a little beyond the sori, 4 on the acroscopic and 3 on the basiscopic side fertile in large fronds; receptacle oblong, sori round or nearly so, superficial, in quite regular oblique rows, sporangia armed with short atrocastaneous bristles, sometimes with two pairs.

Here, I believe, belong two collections from Mt. Kinabalu. Borneo,—*Clemens 27065* and *51361* (the latter number confused in distribution).

This is no near relative of *G. trifurcata,* in spite of some resemblance in form and venation. It is very near to *G. sumatrana,* but apparently distinguishable by thicker texture, brown color, and more regularly seriate sori.

Neither of the two following species is convincingly distinct while known to me by description only.

75a. **POLYPODIUM TORRICELLIANUM** Brause

Polypodium torricellianum Brause, Engl. Jahrb. **49** (1912) 45. *fig. 3A.*

"Phlebodium. Rhizoma breve, erectum, paleis fuscis, peltatis, e basi cordata elongato-deltoideis, integris, usque ad 3.5 mm longis, 0.7 mm latis obtectum. Folia fasciculata, petiolulata. Petioli 0.6–1 cm longi, teretes, cr. 0.7 mm crassi, fusci, pilis brevibus, recte patentibus dense muniti. Laminae coriaceae, rigidae, obscure virides, usque ad 14.5 cm longae, 1.1–1.3 cm latae, ambitu lineari-lanceolatae, in apicem denique sublinearem longe acuminatae, ad basin versus decrescentes, margine crenatae, supra subglabrae, infra margineque pilis brevibus fuscis praeditae; nervis medianis supra sparse, infra dense pilis fuscis armatis; venis supra prominentibus, infra vix conspicuis, ad basin apicemque laminae versus furcatis vel simplicibus, ceteris pinnatis, anastomosantibus, marginem laminae non attingentibus. Sori bi- vel triseriales in utroque nervi mediani latere, paulum immersi, subrotundi, sori seriei nervo mediano proximae ramo antico basilari, seriei secundae ramo postico impositi; sporangiis setosis; sporis subrotundis, lenticularibus, granulatis, flavescentibus.

"Nordöstl. Neu-Guinea: Kaiser-Wilhelmsland, Torricelli-Gebirge, 1000 m. u. M. (Schlechter n. 14347. April 1902).

"Diese Art ist augenscheinlich eine Uebergangsform von der *Eupolypodium*-zu der *Phlebodium*-Grupe."—Brause, l. c.

Except as to venation, this is a typical *Grammitis,* and I do not hesitate to construe it as such. The venation of "young leaves" (meaning small ones, as nobody imagines that the venation changes with the age of the leaf) is that of *Grammitis.* Only two fruiting fronds were seen. The figure shows the veinlets mostly uniting in the second series of sori.

75b. POLYPODIUM CARSTENSZENSE Ridley

Polypodium carstenszense Ridley, Linn. Soc. Trans. Bot. II 9 (1916) 260.

"Rhizoma squamis tenuibus lanceolatis acuminatis pallide brunnescentibus tectum. Frondes simplices, petiolatae, petiolis teretibus pubescentibus 7–8 cm. longis gracilibus; lamina linearis, acuminata, basi cuneata, subcoriacea, margine superne undulata, basin versus breviter lobata lobis obtusis latis, 20 cm. longa, 1.5 cm. lata, nervis circiter 80 undulatis, nervulis 6 brevibus. Sori elliptici, parvi, subimmersi, 6 cum quoqoe nervo in apicibus nervulorum orti.

"Camps XI to XIV, 8300 to 10,500 ft.

"Allied to *P. sumatranum*, Baker, differing in the distinctly lobed fronds and flexuous nerves."—Ridley, l. c. Coll. by Wollaston Exped., Dutch New Guinea, 1912–'13.

Ridley also described at the same time *P. petiolatum* Ridley *non* Davenport, *P. canaliculatum* v.A.v.R., Malayan Ferns Suppl. (1917) 522, said to be allied to *P. carstenszense*, but with argenteous paleae and canaliculate stipes,—features unknown in any *Grammitis*. Mr. Alston has cleared this mystery, writing that it is not a *Grammitis* at all, but a *"Pleopeltis,"*—probably what I would call a *Crypsinus*.

76. GRAMMITIS SUBRETICULATA Copel., comb. nov.

Polypodium subreticulatum Copel., Philip. Jour. Sci. 9C (1914) 6.

"Eupolypodium rhizomate brevi-repente, paleis laete brunneis ovato-lanceolatis dense vestito; stipitibus proximis, 1–2 cm altis, validis, setis purpureo-casteneis ca. 2 mm longis vestitis; fronde usque ad 25 cm alta et 12 mm lata, utrinque sensim attenuata, integra vel subintegra, coriacea, pilis fere nigris sparsis vestita vel in vetustate calva; venis furcatis venulis liberis, vel 2–4 ramos emittentibus et venulis hic illuc haud saepe anastomosantibus; soris irregulariter 2–3-seriatis, superficialibus, orbicularibus vel oblongis.

"Taupota, *King 395, coll. Rev. P. C. Shaw.*

"This suggests *P. congenerum* and *P. diplosorum* Christ, both of which, on the more ample fronds, have sori in plural rows or scattered. The occasional anastomosis of veins is also correlated with the ampleness of the entire frond, and is occasionally seen in the various species of the group . . ."—Copeland, l. c.

Known by the type collection only. The affinity is to G. *setosa* (*P. diplosorum* Christ).

FIG. 54

77. GRAMMITIS ARCHBOLDII (C. Chr.) Copel., comb. nov.

Polypodium Archboldii C. Chr., Brittonia **2** (1937) 305.

"Grammitis rhizomate repente, paleis laete brunneis, ovatis, acutis, integris, 1 mm. latis, dense imbricatis vestito. Foliis 1–2 cm. distantibus; stipite brunneo, 5–8 cm. longis, juventute pilis brunneis, 1–2 mm. longis, patentibus hirto, cito glabro; lamina lanceolata, 8–12 cm. longa, 1 cm. lata, basi cuneata, longe acuminate, integra vel subsinuata, coriacea, obscure viridi, sparsissime et decidue ciliatis, utrinque glabra vel ad costam pilis perpaucis utrinque instructis; venis indistinctis, pinnatis, venulis 1–2-jugis. Soris quoque costae latere biseriatis, sursum uniseriatis, juvenilibus subimmersis, oblongis, interioribus costam non attingentibus, maturis globosis, confluentibus, magnis, sporangiis pilis atrocastaneis, rigidis, stellatis (i. e., apice 3 vel 4 ramos horizontales ferentibus) armatis, mox nudis.

"Type, *Brass 4236*, collected June 17, 1933, on southwestern slope of Mt. Albert Edward, Central Division, alt. 3680 m.; epiphytic among moss, common. Also; Mt. Tafa, alt. 2400 m., *Brass 5093;* epiphytic on lake shore forest trees; stipes brown, the midrib blue-black.

"The cited specimens resemble in size and color *P. Reinwardtii* but differ in the double rows of sori, the outer row still not always developed, and especially by the curious stellate branched hairs on the sporangia, resembling those of *P. brauseanum* v.A.v.R., its nearest relative, from which it differs by the longer stipe with longer hairs, the dark color, the lamina narrower and barely somewhat undulate. The specimens from Mt. Tafa differ somewhat from the type by a longer stipe and quite even margins."—C. Chr., l. c.

Both collections cited by Christensen are in Herb. N. Y. Bot. Garden, Paleae fixed by the middle of the rounded or shallowly cordate base; stipes sparsely but fairly persistently setose. On the New York specimens, the sori are uniseriate on No. *4236* (type collection), irregularly biseriate on No. *5093*. There may be some branched setae,—I am uncertain; commonly they are binate, ternate, or even quaternate, and in contact at the base. They are short, dark, not very persistent. To the same species belong *Keysser* No. *B 50* and *Bamler* No. *B 2*, both from Bolan, alt. 2,400 to 3,800 m, in Herb Univ. Calif., received as *P. diplosorum*. Both have some irregularly placed sori; and the setulae on the sporangia are stellate in origin but not branched. Here also I confidently place *Brass 4259*, doubtfully ascribed by Christensen to *P. moltipilum;* at any rate, the N. Y. Bot. Garden specimen is identical with No. *4236*, collected in the same place.

FIG. 55

78. POLYPODIUM DIPLOSOROIDES Ros.

Polypodium diplosoroides Ros., Nova Guinea 8 (1912) 724.

"*Eupolypodium;* rhizomate breviter repente, squamis flavobrunneis, flaccidis, ovato-lanceolatis, integerrimis vestito; stipitibus subfasciculatis, 1–2 cm. longis, pilis rufo-ferrugineis, longis, setiformibus vestitis; laminis c. 12 cm. longis, ad 1 cm. latis, lineari-lanceolatis, utroversus acuminatis, leviter undulato-crenatis, chartaceis, lividoviridibus, margine sparse rufo-ciliato excepto glaberrimis; costa mediana subtus prominente, aterrima, nervis lateralibus obliquis, medio furcatis, ramo postico saepe iterum furcato, apice incrassatis, opacis, utrinque conspicuis; soris utrinque uniseriatis, costae subapproximatis, ramo antico paullo supra furcaturam impositis, juventute elongatis, sero rotundatis.

"Hab. Nova Guinea neerlandica, in montibus Hellwig-Gebirge dictis, 1350–1600 m.s.m., Nov. 1900, 1. von Roemer no. 1167 et 1317.

"Die Art steht dem *Polypodium diplosorum* Christ am nächsten, das sich durch stärkere und längere Haare, dickere Textur, tiefer gegabelte Nerven ad daher der Rippe näher stehende Sori unterscheidet. Bei no. 1317 treten die Nerven mehr hervor, ihre vorderen Gabeläste sind verlängert."—Rosenstock, l. c.

I do not know this species. Except for being short-stipitate, it would seem to be much like *G. Archboldii;* it would have priority if they were the same. This is true also of *G. subreticulata,* which has setae on the lamina. All are relatives of the Malayan *G. setosa.*

79. POLYPODIUM SUCKLINGIANUM Baker

Polypodium sucklingianum Baker, Annals Bot. 8 (1894) 128.

"Stipitibus brevissimis paleis subulatis brunneis patentibus vestitis, frondibus linearibus simplicibus crenatis obtusis ad basin angustatis utrinque viridibus glabris margine minute ciliatis, venis dissitis erecto-patentibus simplicibus ad apicem loborum productis, soris oblongis superficialibus obliquis utrinque prope costam uniseriatis confertis.

"Hab. New Guinea; Mount Suckling, Sir W. Macgregor; received from Sir F. Mueller.

"Lamina 1½–2 poll. longa, medio 2 lin. lata.

"Near *P. marginellum,* Sw. and *P. australe,* Mett."—Baker, l. c.

I have not seen this. Alston in litt. compares it with *G. knutsfordiana,* and says "*P. sucklingianum* Bak. is superficially similar, but a smaller plant." He has been at the pains of making an enlarged rough sketch of the type,–lost in the destruction of Manila. It is strongly suggestive of *G. Reinwardtii.*

80. GRAMMITIS CILIOLATA (v.A.v.R.) Copel., comb. nov.

Polypodium ciliolatum v.A.v.R., Nova Guinea 14 (1924) 43.

"*Eupolypodium, Integrifolia.*—Rhizoma longe repens; squamulae erectae, lineari-lanceolatae, integerrimae. Stipites 5–30 mm. inter se remoti, 1½–3 cm. longi, in juventute pilis longis, squarrosis, rufo-brunneis muniti, pos-

tremo glabrescentes. Frondes coriaceae, supra obscure brunneae, in sicco fuscae, prope marginem parce, obscure setulosae, ad marginem integerrimum setulis copiosis castaneis vel nigro-brunneis, patentissimis ciliolatae, subtus pallidiores, glabrae, lineari-lanceolatae, 15–20 cm. longae, in medio 4–5 mm latae, apicem obtusiusculum et basin acute cuneatam versus sensim angustatae; costa obscure brunnea, in sico fusca, subtus prominens, parce, breviter castaneo-setulosa; venae indistinctae, obliquae, saepe furcatae, marginem frondis non attingentes, venulis ± aequilongis. Sori utrinque 1-seriati, obliqui, costam quam marginem magis approximati, usque 45 utrinque, partes angustatas superiores inferioresque frondium negligentes, distincte sed non profundissime immersi, in juventute oblongi, maturi suboblongi, remotiusculi; capsulae in juventute copiose, breviter castaneo-setulosae.

"Habit.: Mountain ridge near Doorman Summit, epiphytical in swampy forest, alt. 1420 m., H. J. Lam n. 1518, 5 October 1920."—v.A.v.R., l. c.

Isotypes are in the Leiden and Singapore herbaria. The paleae are brown, up to 5 mm long and to 2 mm broad at the base, mostly appressed; stipes densely hairy, with spreading or deflexed hairs mostly 0.6 mm long but reaching 1 mm; veins forked, the fertile veinlet surpassing the sorus but not quite reaching the margin.

FIG. 56

81. GRAMMITIS CERATOCARPA Copel.

Grammitis ceratocarpa Copel., Univ. Calf. Publ. Bot. 18 (1942) 223.

G. rhizomate brevi-repente, 1.5–2 mm crasso, paleis laete fuscis 2–3 mm longis ovatis integris vestito; stipitibus approximatis, 5 cm altis, 0.7 mm crassis, fuscis, setis debilibus 1–1.5 mm longis sparsis; lamina 15 cm longa, 3–5 mm late, utrinque angustata, rigide coriacea et omnino opaca, glabra, venis occultis ut videtur furcatis; soris inframedialibus sed paginam complentibus, receptaculis impressis elongatis, plerisque costae obliquis, superioribus costae subparallelis, sporangiis setis crassis 2 vel saepius 4 diametro sporangii aequilongis atrofuscis ornatis, cellulis incrassatis annuli 14–16.

NEW GUINEA: Morobe, Ulap trail, alt. ca. 3,000 m, *M. S. Clemens 11349*. April 6, 1940.

Perhaps related to *G. plurisetulosa*, but with short rhizome, very different paleae, and sparsely setose stipes. After cutting away both surfaces, and expelling all air, the internal mesophyll remains so opaque that the veins are still invisible. However, the tips are visible, and indicate that the veins are forked.

82. GRAMMITIS DOLICHOSORA Copel., comb. nov.

Polypodium dolichosorum Copel., Philip. Jour. Sci. 1 Suppl. (1906) 159, *pl. 16*.

"Rhizomate late repente, 1 mm crasso, paleis fulvis amplis ovatis 2–4 mm. longis vestito; stipite duro, fusconigro, pilis rubidis vix 1 mm.

longis vestito vel deorsum glabro, ca. 4 cm. alto, non articulato; fronde ca. 15 cm. alta, 1 cm. lata, utrinque attenuata, apice obtusa, integerrima, glabra, coriacea, opaca; venis plerumque 2-furcatis; soris obliquis, oblongis, in seriem unam inter costam marginemque instructis, costam propioribus, paulo immersis.

"Mindanao, Davao, 1800 m.s.m., *Copeland 1524.*

"A fern related to *P. australe* Mett. and *P. caespitosum* (Blume) Mett., distinguished by the long rhizome, long, stout stipes and coriaceous fronds. Found on the ground, but probably as much at home on trees . . ." Copeland, l. c.

Paleae up to 8 mm long, affixed either at or just above the base; stipe 1 mm thick, hairs reddish-fuscous, sometimes more than 1 mm long; costa and margin sparsely setulose; basiscopic veinlet again forked in the broad part of the frond, acroscopic veinlet ending in the sorus or more commonly somewhat prolonged; young sporangia setulose beside the annulus, the short, dark bristles deciduous.

FIG. 57

MINDANAO: Mt. Apo, *Copeland 1524*, the type, *Elmer 10636, Kanehira 2698* in Herb. N. Y. Bot. Garden; Mt. Matutum, *Copeland P.P.E. 181.* New Guinea: Nassau Geb., *Docters v. Leeuwen 10939;* Brause, Engler's Jahrb. **56** (1920) 179, cites six collections by Ledermann, which I have not seen. BORNEO: Mt. Kinabalu, *Clemens 32407 partim, 33965, Holttum 25533.*

83. POLYPODIUM PAPUENSE v.A.v.R.

Polypodium papuense v.A.v.R., Malayan Ferns Suppl. (1917) 521.

P. papuanum Ridley, Linn. Soc. Trans. Bot. **9** (1916) 261, *non* Baker.

"Herba parva, caespitosa, 5 cm. alta. Frondes sessiles, lineares, angustae, 1 mm. latae, paullo acuminatae, obtusae, versus basin paullo attenuatae, subcoriaceae, pilis atris paucis munitae, costa elevata, nervis celatis. Sori in apice copiosi, elliptici, primo distantes, mox congesti, laminam tegentes.

"Camp III, 2500 feet.

"Allied to *P. universe*, Baker, but less coriaceous and less hairy, with many more sori."—Ridley, l. c.

Coll. by Wollaston Exped., Dutch New Guinea, 1912–'13.

Unknown to me. To place it in the key, I have assumed the presence of paleae, but have avoided any assumption as to the veins. Mr. Alston queries "Could it be a subglabrous almost entire state of *G. inconstans?*"

84. GRAMMITIS MARIAE Copel.

Grammitis Mariae Copel., Univ. Calif. Publ. Bot. **18** (1942) 223.

Rhizomate breve, repente, paleis brunneis ovatis 1.5 mm longis vestito; stipitibus fasciculatis, 1.5–2 cm longis, 0.5 mm crassis, setis rubido-castaneis 1 mm longis dense vestitis; lamina 6 cm longa, 8 mm lata, obtusa, basi cuneata, oblique inciso-dentata, papyracea, ubique sed praecipue ad costam venasque et circum soros setis iis stipitum conformibus onusta; venis perconspicuis, crassis, prope costam furcatis etiam rarissime marginem versus venulam basiscopicam emittente, venula fertile vix supra sorum protracta; soris costalibus, oblongis, superficialibus, setis protectis, sporangiis copiose setuliferis, annulis albis.

FIG. 58

NEW GUINEA: Morobe, above Ogao, alt. 8,000 to 10,000 feet, in mossy bush, *Mary Strong Clemens 10251a*, June 19, 1939, type; also, Rawlinson Range, alt. ca. 12,000 feet.

The type specimen is one plant, with one fertile and one sterile frond. The very conspicuous venation is like that of *G. Reinwardtii*, and does not suggest that there might ever be a second row of sori. The incision of the margin is quite uniform, except as the margin becomes crenate toward apex and base. Apparently very distinct; but Mr. Alston suspects that it may be a sport of *G. sucklingiana*.

85. GRAMMITIS HIRTIFORMIS (Ros.) Copel., comb. nov.

Polypodium hirtiforme Ros., Fedde's Repert. 12 (1913) 176.

"*Eupolypodium;* rhizomate brevi, erecto, c. 1½ mm crasso, paleis ovatis, minutis, ferrugineis (sub pilis stipitum absconditis) vestito; stipitibus densis, capillaribus, c. 2 cm longis, pilis rufis mollibus patentibus dense ornatis; laminis simplicibus, lineari-oblongis, obtusiusculis, deorsum longe angustatis, ad 10 cm longis, 2½–3 mm latis, viridibus, subtus paullo pallidioribus, membranaceis, pilis iis stipitum similibus et aequalibus praesertim ad costam et marginem utrinque vestitis; costa mediana cum venis utrinque prominente; venis lateralibus plane conspicuis, nigris, inferioribus et superioribus simplicibus exceptis furcatis, medialibus e parte inferiore, costae parallela furcatis, ramo posteriore marginem arcuatim petente, anteriore valde abbreviato, recto, dorse sorifero; soris costae medianae subcontiguis, sporangiis setis 1–2 deciduis ornatis.

"Nova Guinea germanica, in montibus Bolan dictis, 2400–3000 m alt.; 1912, l. c. Keysser no. B. 48.

"Das unserer Art am nächsten stehende *P. mollipilum* Bk. unterscheidet sich von ihr durch breiteres Blatt (6–7 mm), dickere härtere Textur und dichtere Behaarung. Beide gehören ihrer Nervatur nach zur *hirtum*-Gruppe."—Rosenstock, l. c.

Isotype in Herb. Univ. Calif. Rosenstock's description is exceptionally accurate and complete. Paleae almost suppressed by the dense mass of hairy stipe-bases; hairs as dense as possible at the base, 2 to 3 mm long, sparse upward, on the lamina very sparse, 1½–2 mm long; veins at a very acute angle to the costa; sori occupying the whole of the fertile veinlets.

FIG. 59

86. GRAMMITIS MATAPENSIS Copel.

Grammitis matapensis Copel., Univ. Calif. Publ. Bot. 18 (1942) 223.

G. rhizomate 1.5 mm crasso, adscendente, paleis stramineis, 1.5 mm longis late lanceolatis obtusis vestito; stipitibus approximatis 1–1½ cm longis, 0.2 mm crassis, setis cinnamomeis, 1.5 mm longis vestitis; lamina usque ad 10 cm longa et 7 mm lata, membranacea, setis atrofuscis usque ad 3 mm longis adspersa et ciliata; venis sterilibus simplicibus ad marginem non attingentibus; soro costale, ramum fertilem brevem venae complente, orbiculare, superficiale, sporangiis setulis obscuris, quam diametro sporangii duplo longioribus, ornatis.

FIG. 60

NEW GUINEA: Morobe, Matap, alt. ca. 1,700 m, *M. S. Clemens 11176*. March, 1940.

This is the New Guinea representative of *G. Reinwardtii*, from which it differs essentially by thinner texture. The veins of *G. matapensis* are conspicuous by transmitted but not by reflected light. Of New Guinea species, it is nearest to *G. hirtiformis*, which has much narrower fronds, dense hairs at the base of the stipe, and forked sterile veins.

87. GRAMMITIS DEBILIFOLIA Copel.

Grammitis debilifolia Copel., Univ. Calif. Publ. Bot. 18 (1942) 223.

G. rhizomate breve adscendente, paleis fuscis ovatis 1–½ mm longis inter stipites absconditis vestito; stipitibus fasciculatis, 3 cm longis, filiformibus, frondeque ubique pilis rufo-castaneis 2–2½ mm longis dense vestitis; lamina usque ad 10 cm longa, 3 mm lata, apicem versus obtusum breviter angustata, deorsum sensim longissime attenuata, herbacea; costa inferne praestante, venis obscure perspicuis, costae subparallelis, furcatis; receptaculo elliptico, superficiale, subcostale, ad

FIG. 61

venulam longam fertilem infra-mediale, soro globoso ad costam sed vix ad marginem expanso, sporangiis setis longis paucis ornatis.

DUTCH NEW GUINEA: "2 Km E. of Wilhelmina-top, alt. 3,800 m in subalpine forest, plentifully tufted on mossy trees." *L. J. Brass* and *E. Myer-Drees* 10036. September, 1939.

Group of *G. fasciculata;* well distinguished by the long, narrowly oblanceolate-linear pendent fronds, and the very narrow angle of the veins. Mr. Alston refers here *Carr 15130* (?); and *Clemens 7343, 6236, 6233,* from Mt. Sarawaket, in the British Museum.

88. GRAMMITIS MYER-DREESII Copel.

Grammitis Myer-Dreesii Copel., Univ. Calif. Publ. Bot. 18 (1942) 223.

G. rhizomate breve, adscendente; paleis paucis, vix 1 mm longis, ovatis, obtusis, stipitum basibus occultis et fere suppressis; stipitubus dense fasciculatis, usque ad 9 cm longis, gracilibus, fuscis, pilis sparsis inconspicuis gracilibus 1–2 mm longis vestitis; lamina usque ad 13 longa, 7 mm lata, acuminata, attenuato-decurrente, integra vel undulata, subcoriacea, setis 1.5 mm longis perpaucis vestita et ciliata; venis furcatis venulis aequalibus fere ad marginem protensis; soris subcostalibus, ad vennulas fere basalibus, superficialibus, oblongis vel suborbicularibus, aporangiis setis atrocastaneis multis quam diametro capsularum duplo longioribus munitis.

FIG. 62

DUTCH NEW GUINEA: 7 Km northeast of Wilhelmina-top, alt. 3,580 m, *Brass* and *Myer-Dress 9898.* "Subalpine forest; tufted in moss; not common."

Distinguished from *G. inconstans* by long and sparsely hairy stipes; from *G. debilifolia* by comparative nakedness of frond but densely setose sporangia; from *G. hirtiformis* by elongate fertile veinlets. The four species are clearly related, and collectively related to the group of *G. fasciculata.*

89. GRAMMITIS BREVISETULOSA Copel.

Grammitis brevisetulosa Copel., Univ. Calif. Publ. Bot. 18 (1942) 223.

G. rhizomate breve, paleis ferrugineis anguste ovatis 1 mm longis cellulis maximis vestito; stipitibus confertis tenuiter filiformibus, 1 cm longis, fuscis, pilis gracilibus vix 1 mm longis ferrugineis vestito; lamina 5.5 cm longa, 4–5 mm lata, apice rotundata, basi attenuata, diaphana, setis paucis inconspicuis ciliata et adspersa, costa sinuata, venis patentibus, furcatis, venulis divergentibus a

FIG. 63

margine late remotis; soris superficialibus, orbicularibus, subcostalibus, prope basin venulae acroscopicae elongatae positis, sporangiis setulis atrocastaneis plerumque quam diametro sporangii vix longioribus munitis.

NEW GUINEA: Morobe, Matap. alt. 1,700 m, *Mary Strong Clemens s. n.;* a single plant with six fertile fronds, mixed with *No. 40969, G. matapensis,* which has the fertile veinlet only long enough to bear the sorus. The most remarkable peculiarity of *G. brevisetulosa* is the size of the cells of the paleae,—large enough to be counted with the hand lens.

90. GRAMMITIS INCONSTANS (v.A.vR.) Copel., comb. nov.

Polypodium inconstans v.A.v.R., Nova Guinea **14** (1924) 43.

"*Eupolypodium, Integrifolia.*—Rhizoma breve; squamulae parvae, lanceolato-ovatae, pallide ferrugineae acutae, integerrimae. Stipites breves, approximati, usque ad 5 mm. longi, pilis multis squarrosis, longiusculis rubro-brunneis ornati. Frondes coriaceae, utrinque (praesertim marginem versus) pilis longis, rubro-brunneis vel castaneis laxe munitae, supra obscure virides, in sicco fuscae, subtus pallidiores, lineari-lanceolatae ± 4½ cm. longae, dentibus elongatis exclusis ± 3 mm. latae, parte inferiore supra basin acute cuneatam, integerrimam repando-crenatae, hic illic longiuscule serratae, apice subintegerrimae, acutae; costa valde obscure viridis, in sicco fusca, leviter prominens, utrinque parce, longe pilosa; venae indistinctae, remotae, valde obliquae, furcatae, in sicco prominentes. Sori ± dimidiam partem superiorem frondium occupantes, costales, ad basin venularum anticarum positi, maturi confluentes, costam occultantes, marginem frondium fere attingentes; receptaculum oblongum; capsulae in juventute breviter castaneo-setulosae.

"Habit.: Mountain ridge near Doorman Summit, epiphytical in forest, alt. 1450 m., H. J. Lam n. 1882, 2 November 1920."—v.A.v.R., l. c.

This is like the case of *G. ludens.* Again the emphasis is on a peculiarity likely to be individual instead of specific; for it seems unlikely that a species with fronds only 3 mm wide should be characterized by conspicuous irregularity of margin. Leaving the margin out of account, this should be recognizable by short, hairy stipes, and small, sparsely hairy lamina. It may be near *G. hirtiformis.*

A photograph of the type, sent me by Mr. Alston, is good enough to show that the veins are prolonged beyond the sori, as is indicated by the description. Aside from the irregular margin, which I mistrust as a character, this must differ from *G. hirtiformis* by having elongate fertile veinlets; from *G. habbemensis* by being smaller and sparsely hairy; from *G.*

debilifolia by being short-stipitate and less hairy; from *G. Myer-Dreesii* by having short and more hairy stipes. I do not like to describe three new species in this group, and from the same region, without personally knowing this one. But the three are certainly distinct from one another, and each is represented by a single collection, showing the extreme local diversification of the group. As *G. inconstans* would have priority if identity with any of them were established, I transfer the name.

91. GRAMMITIS HABBEMENSIS Copel. **Plate 5.**

Grammitis habbemensis Copel., Univ. Calif. Publ. Bot. 18 (1942) 223.

G. caudice breve erecto, paleis pallide brunnneis 1.5 mm longis et lanceolatis et ovatis membranaceis decidue apiculatis vestito; stipitibus fasciculatis, 1–2 cm longis, 0.3 mm crassis, fuscis, laminaque ubique setis castaneis usque ad 3 mm longis dense onustis; lamina 25 cm longa, 8 mm lata, obtusa, basi attenuata, integra, crasse herbacea (viva verisimiliter spongiosa), subdiaphana, costa immersa; venis luce transmissa conspicuis, furcatis, ramulo sterile interdum furcato; soris uniseriatis, superficialibus, orbicularibus, ad mediam laminam et ad venulam inframedialibus, setis laminae protectis, etiam sporangiis setis atrocastaneis ornatis.

FIG. 64

DUTCH NEW GUINEA: 9 Km N. E. of Lake Habbema, alt. 2,860 m, *1. L. J. Brass 10520,* "low tuft epiphyte in mossy forest; fronds pendent."

A relative of *G. fasciculata,* more slender and more densely hairy; very like *G. ornatissima* in appearance, but more hairy, and with the sori above the bases of the elongate fertile veinlets.

Mr. Alston writes: "This seems to be the true *P. oblanceolatum* Baker, as represented by Alola, *Carr 13665* (BM); Lala River, *Carr 14037* (BM); Angi Lakes, *Gibbs 8881* (BM); Mt. Suckling McGregor (K)." The last is the type of *P. oblanceolatum* (No. 56). It may be recalled that *P. oblanceolatum* was described as with naked stipe and lamina, lamina up to 5 cm long, crenulate, bearing a few brown subulate paleae, the sori at the forking of the veins. This description would raise no suspicion of identity, and is so completely inappropriate to *G. habbemensis* that I let the latter stand. However, no description has any standing as against the type.

92. GRAMMITIS ORNATISSIMA (Ros.) Copel., comb. nov.

Polypodium ornatissimum Ros., Fedde's Repert. 5 (1908) 41.

"*Eupolypodium;* rhizomate tenui, erecto, caespitoso; stipitibus dense fasciculatis, tenuibus, 4–6 cm longis, ut tota planta pilis mollibus, patentibus, atropurpureis, 5–6 mm longis, simplicibus vel fasciculatis undique instructis; laminis pendulis, longe lineari-lanceolatis, usque ad 60 cm longis, 1 cm latis, basi longe attenuatis, apice acutis, margine integerrimis vel leviter undulatis, membranaceis, pellucidis; nervo mediano atrato, subtus prominente, nervis lateralibus plane conspicuis arcuatis, semel vel bis furcatis, ramulis brevissimis, apice incrassatis, in facie superiore squamulis peltatis, rotundis, albido-ceraceis obtectis, basalibus soriferis; soris apicalibus, rotundis, utrinque uniserialibus, nervo mediano approximatis; sporangiis nudis.

"Nova Guinea: in monte Gelu, prope 'stationem,'" c. 1000 m alt.—leg. Dr. E. Werner, VII, 07 No. 47.

"Die durch schmale, bandförmige Blätter, purpurfarbige, lang abstehende Behaarung sowie durch die in 4 Längsreihen angeordneten weissen Schüppchen der Oberseite ausgezeichnete Art kommt dem *P. setigerum* Bl. am nächsten, das sich durch küzeres, aber länger gestieltes Blatt, dickere Textur, dorsale Sori und den Mangel der Wachsschüppchen auf der Oberseite der Lamina unterscheidet."–Rosenstock, l. c.

Var. *dichotomum* Brause, Engl. Jahrb. 56 (1920) 180 "Differt laminis paulo angustioribus, dichotomis."—*Ledermann 11809; Ledermann 11448a,* typical.

Well named and well described. As in congested forms of *G. fasciculata,* the paleae are invisible without dissection. The species is very distinct, but evidently related to *G. fasciculata.*

Isotypes in Herb. Univ. Calif. and U. S. Nat. Herb.; *V. Roemer 734,* in Herb. Lugd. Bat., det. Rosenstock.

FIG. 65

93. GRAMMITIS MOLLIPILA (Baker) Copel.

Grammitis mollipila (Baker) Copel., Univ. Calif. Publ. Bot. 18 (1942) 224.

Polypodium mollipilum Baker, Jour. Bot. 28 (1890) 107.

"Rootstock not seen. Stipe slender, brown, wiry, 1–1½ in. long, clothed with fine spreading hairs. Frond simple, linear, entire, 2–4 in. long, ¼ in. broad at the middle, narrowed gradually to the base and apex, moderately firm and thick, densely clothed with fine spreading brown hairs. Veins forked. Sori globose, superficial, costular.—Near the summit of the Owen Stanley range. Near *P. Hookeri* Brack., and *P. hirtum* Hook."

Christensen, Brittonia 2 (1937) 305, discusses *P. mollipilum, P. trichopodum* and *P. oleandroides. P. mollipilum* is acuminate, long-stalked, long-hairy throughout; *P. oleandroides,* rounded or

obtuse, shorter-stalked, comparatively naked; but Christensen suggests that they may be forms of one species.

P. mollipilum is a puzzle, not solved for me by Christensen's discussion. The original publication follows the republication of *P. trichopodum,* and the sole positive distinction is that the latter has fronds 1 to 2 inches long and $\frac{1}{6}$ inch wide, while *P. mollipilum* has them 2 to 4 inches by $\frac{1}{4}$ inch. Presumably they are really different. Both are evidently in the group of *G. fasciculata,* which is well represented in New Guinea.

Brass and *Myer-Drees 9841* can represent *G. mollipila,* and is not referable to any of the other species. It differs from *G. trichopoda* in stouter stipe and relatively long and firm lamina; from *G. fasciculata* and *G. ornatissima,* in texture, both of them being herbaceous or spongy, while this is subcoriaceous and opaque.

Paleae fuscous, up to 2 mm long but somewhat suppressed by the densely fascicled stipes; hairs of stipe and margin up to 2 mm long, mostly shorter, and dense; veins at an acute angle, forked well above the base; sori subcostal or inframedial, superficial, round and contiguous, but the receptacle elongate at the base of the elongate veinlet; sporangia setulose.

94. GRAMMITIS TROGOPHYLLA Copel.

Grammitis trogophylla Copel., Univ. Calif. Publ. Bot. 18 (1942) 224.

Rhizomate breve, adscendente, paleis brunneis integris 1–1½ mm longis vestito; stipitibus confertissimis, 2–3 cm longis, 0.3 mm crassis, frondeque ubique pilis vinicoloribus usque ad 3 mm longis densissime setosis; lamina ca. 6 cm longa, 5 mm lata, obtusa vel subacuta, basi decurrente, integra, subcoriacea; venis omnino inconspicuis, furcatis ramo fertile plus minus supra sorum protracto; soris subcostalibus, orbicularibus, superficialibus, sporangiis deciduo setiferis, annulo castaneo excepto albidis.

FIG. 66

NEW GUINEA: Morobe, Mt. Sarawaket, alt. 11 to 12,000 feet. *Mrs. M. S. Clemens s. n.,* May, 1939, type. *Clemens 10087,* alt. 9 to 10,000 feet, March, 1939, is this species, but my specimen is fragmentary. Almost identical is *Brass 9855,* Mt. Wilhelmina, alt. 3,560 m.

A very distinct species, like *G. Wattsii* of Lord Howe Island in its extreme hairiness. The local affinity is to *G. mollipila,* as I understand that species.

95. GRAMMITIS CYCLOSORA Copel.

Grammitis cyclosora Copel., Univ. Calif. Publ. Bot. **18** (1942) 224.

G. caespitosa, paleis 1–1.5 mm longis, brunneis; stipitibus fasciculatis, 5–8 cm longis, 0.6 mm crassis, setis vinicoloribus patentibus 1.5 mm longis dense vestitis; lamina 5–8 (rarius usque ad 10) cm longa, 5–10 mm lata, acuta vel obtusa, basi decurrente, integra, subcoriacea, setosa; venis furcatis, ramis ambobus elongatis ad marginem non protensis; soris costalibus, superficialibus, orbicularibus, sporangiis setuliferis.

FIG. 67

NEW GUINEA: Morobe, Mt. Sarawaket, alt. 11,000 to 12,000 feet. *Mrs. M. S. Clemens s. n.*, June 7, 1939; another fragment collected at 12,500 feet, June 16.

Many loose fronds received, but the two individuals with rhizomes seem to be juvenile; their rhizomes are short and erect. Otherwise, this is much like *G. trichopoda* in appearance, but the venation is distinctive. It is a relative of *G. setosa* Blume, which has relatively long laminae in proportion to the stipe, and is less persistently hairy, with less red in the hairs.

96. GRAMMITIS TRICHOPODA (Mueller and Baker) Copel.

Grammitis trichopoda (Mueller and Baker) Copel., Univ. Calif. Publ. Bot. **18** (1942) 224.

Polypodium trichopodum F. Mueller, Trans. R. S. Victoria **1** (1889) 40; Jour. Bot. **28** (1890) 107.

"Rhizome short-creeping, ⅛ in. diam., densely clothed with small ovate imbricated pale brown paleae. Stipes very slender, contiguous, brown, wiry, clothed with inconspicuous fine spreading hairs. Frond simple, linear, entire, 1–2 in. long, ⅛ in. broad, narrowed gradually to the base, thick and moderately firm in texture, clothed with fine spreading brown hairs. Veins erecto-patent, forked. Sori globose, superficial, costal.—Mount Victoria and Mount Knutsford. Very distinct."—Quoted from Baker, Jour. Bot.

"Rhizome rather wide-creeping, clothed with ovate, pale brown, entire, imbricated scales. Stipe and lamina with spreading brown hairs 1 mm. long throughout; stipe filiform, 5–6 cm. long; lamina 8–9 cm. by 5–6 mm., short cuneate at base, long attenuate to the subacute apex, papyraceous, dark brown when dried; veins rather indistinct, once or twice forked, the branches occasionally anastomosing as in the preceding species (*P. murrayanum*); sori large, globose, oblong and somewhat impressed when young, close to the midrib, with several long hairs; sporangia with some short erect setae."—C. Chr., Brittonia **2** (1937) 305. Mt. Albert Edward, alt. 3680 m, *Brass 4260*.

Var. *serrato-lobatum* Brause, Engl. Jahrb. **56** (1920) 179.

"Differt colore laminae obscuriore, lamina supra olivacea infra pallidiore, margine regulariter serrato-lobato, nervis crassis, paulo magis approximatis, loborum apices fere attingentibus, apicibus loborum pilis densis munitis."—Brause, l. c. Kaiserin-Augusta-Fluss- (Sepik) Gebiet, 1150 m alt.; *Ledermann 11576;* the typical form also there, *Ledermann 12973a.*

I have not seen the type, but have *Brass 4260,* in Herb. N. Y. Bot. Garden, well described by Christensen, who says "I am very sure of this determination." The paleae are 1.5 to 2 mm long, and the setae may reach 1.5 mm. I would call the sori superficial. Young sporangia are freely setulose.

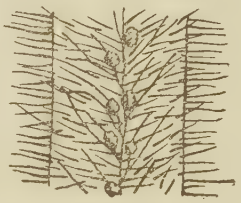

FIG. 68

97. GRAMMITIS NIGROPALEATA Copel.

Grammitis nigropaleata Copel., Univ. Calif. Publ. Bot. 18 (1942) 223.

G. rhizomate brevi-repente, paleis lanceolato-ovatis acutis nigris 1–1.5 mm longis vestito; stipitibus approximatis, 3–5 cm longis, 0.4–0.6 mm crassis, setis debilibus cinnamomeis 3–4 mm longis sat dense ornatis; lamina 10 cm longa vel longiore, 6–10 mm lata, utrinque longe attenuata, integra, coriacea, sicca opaca, ubique setosa, venis bis furcatis; soris inframedialibus, prope basin venulae acroscopicae fere ad marginem elongatae impositis, orbicularibus, leviter impressis, sporangiis setis longis atrocastaneis deciduis ornatis.

FIG. 69

NEW GUINEA: Morobe, Matap, alt. 1,700 m, *Mary Strong Clemens 41018.*

Near *G. trichopoda* as represented by *Brass 4260,* but with stouter stipes, and longer setae on stipe, lamina and sporangia; and particularly distinguished by the small, blackish paleae.

98. GRAMMITIS FASCICULATA Blume

Grammitis fasciculata Blume, Flora Javae II (1829) 112, *pl. 47, fig. 2.*

Polypodium fasciculatum Presl, Tent. (1836) 180.

P. setigerum Blume, Enum. (1828) 123.

P. heanophyllum Copel., Philip. Jour. Sci. 40 (1929) 310.

"G. frondibus longe stipitatis spatulato-linearibus obtusis basi attenuatis integerrimis membranaceis sub-aveniis stipiteque setosis, soris rotundis costae approximatis, caudice sub-caespitoso paleaceo. Bl.

"Polypodium *setigerum* Blume Fil. Jav. p. 123.7.

"Habitat: Summo in monte Gedé Javae ad arbores. Distinguitur a G. *pusilla* Bl. fronde majore, longius stipitatâ venisque maximam ad partem

trifidis, prout G. *hirta* Bl. substantiâ frondis magis elongatae, minus obtusae breviusque stipitatae deflectit.

"Filicula elegans, 4–6-pollicaris.

"Caudex brevis, sub-caespitosus, vix pennae columbinae crassitie, fuscus, sursum paleaceus, superne frondiger, undique radiculosus . . . Paleae confertissimae, lanceolatae vel lineari-lanceolatae, acutae, sub-integerrimae, tenuissimae, scariosae, pallide ferrugineae, reticulatae.

"Stipites adscendentes, inter caudicis paleas fasciculatim emersi, filiformes, crassitie setae porcinae, 1½–3–pollicares, flavicantes, hirsuti pilis tenerrimis, longis, patentissimis aut deflexis, pallide ferrugineo-flavidis.

"Frondes magnitudine valde inaequales, 1½–5–pollicares, 3–4 lin. latae, lineares, rarius lanceolatae, rotundato-obtusae, raro obtusiusculae, basi acutae, integerrimae vel levissime repandae, membranaceae, planae, exsiccae diaphanae, utrinque setis similibus, atque stipites, hirsutae, costâ mediâ solum subtus distinctâ. Fronde lumini obversâ apparent venae parallelae, trifidae, ad frondis basin apicemque modo furcatae, ad marginem fere pertingentes.

"Sori rotundi, magni, ferruginei, utrinque prope costam sub-alterni, a basi ad apicem dispositi, non confluentes, sed semper discreti."—Blume, Flora Javae.

The diagnosis, the first paragraph above, is quoted with slight modification from the Enumeratio. The latter work, bearing the same date as Flora Javae, has priority, so that *Polypodium setigerum* was the first name of this species, but is not available for it in *Grammitis*. Herb. Lugd. Bat. contains three sheets apparently dating from Blume; of these, No. 908, 286 . . . 100 may be selected as the common type of *P. setigerum* and *G. fasciculata*.

FIG. 70

Blume's description and figure apply to a small form of the species, and to the texture of young fronds. Backer and Posthumus, Varenflora voor Java, p. 191, describe it better; "Grootere volwassen bladeren 13–20 mm breed, 14–40 cm lang, lijnvormig, . . . in consistentie met dik vloeipapier overeenkomend." The paleae are usually evident, lanceolate, and 4 to 5 mm long on large plants, smaller but conspicuous on small plants, concealed and much smaller on some luxuriant old plants with crowded stipe-bases which conceal the paleae. The small form, which might seem to typify *G. fasciculata* in distinction to *P. setigerum*, is sometimes hereditarily distinct,

but may be that of young plants or of exposed plants; it is the only form known in Luzon. Maturing sporangia are setose, sometimes with plural hairs considerably exceeding the diameter of the sporangia.

P. heanophyllum was distinguished by thinner fronds and small paleae. It seems fairly uniform in Mindanao, and is also in Ceram; but I find now that it is hardly outside the range of variation in Java.

JAVA: over 30 collections in hand, mostly from the Gedeh, but also throughout the island, in the mossy forest at the greater altitudes; SUMATRA: Mt. Koerintji, *Bünnemeyer 9853, 10061, 10591, Holttum 26215;* CERAM: *Stresemann 232;* TIMOR: *Posthumus 3245;* DUTCH NEW GUINEA: *Brass 10042 A;* MINDANAO: Mt. Matutum, *Copeland P. P. E. 185,* type of *P. heanophyllum;* Mt. Apo, *Copeland 1000, 1059, 1204, 1521, Williams 2492, Elmer 11440;* LUZON: Mt. Pulog, *For Bur. 16295, Copeland P. P. E. 134;* BORNEO: Mt. Kinabalu, *Clemens s. n., Holttum 25739.*

"Filicula elegans" indeed! It is the showiest common *Grammitis,* and accordingly the most collected.

98a. **POLYPODIUM INTROMISSUM** Christ

Polypodium intromissum Christ, Fil. Saras, (1896); Ann. Buit. 15 (1897) 148, *pl. 15, fig. 20.*

"Nahe dem bekannten P. setigerum Blume (Grammitis fasciculata Blume Fil. Jav. 472) aber dünner, kleiner und an haarfeinen verlängerten Stielen, lang herabhängend.

"Stipes haardünn, länger als der 5 bis 6 cm. lange ¾ bis 1 cm. breite ovallanzettliche, nach beiden Enden stumpf zulaufende Wedel.

"Textur nicht korkartig-lederig, wie setigerum, sondern papierartig dünn, Farbe gelbgrün, später braun, Costa deutlich, Seitennerven fiederig gegabelt, Gabeln mit 2 bis 3 Aesten jederseits, Sori in je 1 Reihe, fast costal, an der untersten Gabelung, zuletzt in eine Linie zusammen fliessend. Ganze Pflanze mit 2 Mm. langen rothbraunen abstehenden Haaren zottig.

"Loc. S. 1368. Wawo Keraeng Gifelregion X. W. 16783 ebenda."—Christ (1897). Celebes.

I have seen no specimen referred to this species, but do have specimens of *G. fasciculata* with the stipe as long as the lamina; and these small fronds do not have the spongy or corky texture developed as is characteristic of large forms. Until I see a specimen, I suspect that this is a form of *G. fasciculata.*

99. **GRAMMITIS MURRAYANA** (C. Chr.) Copel., comb. nov.

Polypodium murrayanum C. Chr., Brittonia 2 (1937) 304.

"*Grammitis* rhizomate brevissime repente, paleis pallide brunneis, lanceolatis, integris vestito, foliis subcaespitosis. Stipite filiformi, 2–3 cm. longo, pilis pallidis, tenuibus, patentibus hirto, lamina lanceolata vel

oblanceolata, 3 cm. longa, 5 mm. lata, basi breve cuneata apice obtusa vel acuta, subcoriacea, pilis brunneis, 1 mm. longis utroque latere primum sat dense pilosa et ciliata, aetate denudata; venis luce transiente solum visibilibus, omnibus furcatis, ramulis convergentibus et non raro prope marginem anastomosantibus, interdum iterum furcatis. Soris costalibus, superficialibus, globosis (juventute non oblongis), pilis rufis longis primum obtectis.

"Type, *Brass 4726*, collected Aug. 6, 1933, at Murray Pass, Wharton range, Central Division, alt. 2840 m.; on wet rocks on banks of a creek flowing through grasslands.

"Certainly very near *P. oblanceolatum* Baker, which resembles it in size, but the lamina long attenuate below to a short stipe, distinctly undulate-crenate and less hairy. Also near *P. albosetosum* Bailey. The anastomosis of the veins is perhaps more casual than a consistent character."—C. Chr., l. c.

Specimens: Isotype in Herb. N. Y. Bot. Garden; *Clemens 10364*, Mt. Sarawaket, alt. 12,000 feet, on bowlder in mossy brush; *Clemens s. n., ibid.* 12,500 feet, in grassland.

I would call the paleae dark, rather than "pallide brunneis." The Clemens collection are in part identical with Brass', but in part younger than in the New York isotype. Fertile veinlet always prolonged. The casual anastomoses are remarkable in fronds so small. Sori becoming confluent in full fruit; sporangia, at the right age, bearing short, dark, stout setulae.

FIG. 71

This has the aspect of an Alpine relative of *G. fasciculata.*

100. GRAMMITIS KNUTSFORDIANA (Baker) Copel.

Grammitis knutsfordiana (Baker) Copel., Univ. Calif. Publ. Bot. **18** (1942) 224.

Polypodium knutsfordianum Baker, Jour. Bot. **28** (1890) 107.

P. oleandroides Baker, Annals Bot. **8** (1894) 128.

P. Warburgii Christ, Monsunia I (1900) 59; C. Chr., Gardens' Bull. **7** (1934) 295.

"Rhizome short-creeping, 1/12 in. thick, clothed with small pale brown densely imbricated paleae. Stipe very short, densely clothed with brown spreading hairs. Frond simple, linear, entire, 3–4 in. long, ¼ in. broad, firm in texture, clothed with a few spreading brown hairs, obtuse, narrowed gradually to the base. Veins distinct, furnished with 2 short anterior branches. Sori globose, superficial, forming 2 spaced-out rows near the midrib.—Mount Knutsford. Also allied to *P. zeylanicum.*"—Baker, l. c.

I am indebted to Mr. Alston for the identification of *P. oleandroides* with *P. knutsfordianum,* and of *Brass 12500* as this species. *P. Warburgii* was based on a Batjan specimen; I construe it by Christensen, l. c., dealing with a plant of Mt. Kinabalu.

P. knutsfordianum was described with the lamina "clothed with a few spreading brown hairs." This is true of *Brass 12500*. They are somewhat more abundant on *Brass 12024*. *P. oleandroides* should have the the laminae "glabris margine paleis paucis brunneis subulatis ciliatis." This exactly fits Brass *12011* and *12440*. As to these specimens only, the difference would seem to be real and specific,—and perhaps it is so. But, *Brass 9376* (which is quite exactly like the Borneo plant), *Keysser B. 67*, and *Docters v. Leeuwen 10854*, Nassau-Geb., are intermediate, both in the distribution and in the character of the hairs. Other specimens are *Elmer 10636 B*, from Mt. Apo, Mindanao, distributed as *P. pubinerve; Holttum 25741* (mixed with *G. Reinwardtii*), *Clemens 29035, 31921*, all from Mt. Kinabalu.

New Guinea specimens cited by Mr. Alston are: Mt. Knutsford, *MacGregor 29* (K); Mt. Suckling, *MacGregor s. n.* (K. type of *P. oleandroides*); Mt. Treub, *Pulle 1076* (BM); Mt. Hellwig, *Pulle 676* (BM); N.W. of the Gap, *Carr 15130* (BM); Mt. Sarawaket, *Clemens 6236a* (BM); Mt. Obree, Owen Stanley Range, *R. L. Turner* (BM); Carstenz Mts., VI c Camp, *Kloss* (BM).

Rhizome creeping, 1 mm thick, clothed with appressed, lanceolate or ovate, firm, naked, ochraceous, fuscescent paleae 1.5 to 2.5 mm long; stripes 2 to 10 mm apart, 2 to 5 cm long, 0.6 to 1.2 mm thick, densely beset with reddish-fuscous squarrose (some deflexed) setae up to 2 mm long; lamina up to 25 cm long and 1.3 cm broad, attenuate to both ends, entire or obscurely crenulate, brown, coriaceous, naked except for appressed marginal setae, or everywhere rather sparsely setose with black bristles up to 2 mm long; veins very conspicuous, forked near the costa, and the basiscopic branch again forked (and rarely still again), its divaricate branches approaching the margin; the acroscopic branch short, bearing a terminal, subcostal, roundish sorus; sporangia bearing sparse, dark, stout setulae. The most distinctive features of the species are its very conspicuous veins, salient on both surfaces, and the stout, densely hairy stipes.

FIG. 72

The subject of Christensen's comment on *P. oleandroides*, Brittonia 2 (1937) 305, is *Brass 4259*, which is not at all the species which has just been described.

101. GRAMMITIS HISPIDA Copel.

Grammitis hispida Copel., Univ. Calif. Publ. Bot. 18 (1942) 224.

G. knutsfordianae affinis, terrestris, rhizomate latissime repente, paleis stramineis lanceolatis 3 mm longis deciduis vestito, denique nudo; stipitibus 3–5 cm remotis, 3–6 cm altis, 1 mm crassis, setis ca. 1 mm longis rufo-castaneis densissime vestitis; lamina ca. 25 cm longa, 1.5 cm lata, acuta, basi decurrente, coriacea, brunnescente, ubique setulis atris 0.2–0.5 mm longis dense hispidula margine setulis paullo longioribus ciliato; costa valida, venis utraque facie conspicuis, prope costam furcatis, venula basiscopica patente furcata, in fronde latissima bis furcata; soris subcostalibus ad vel prope apices venularum superficialibus, plerisque paullo elongatis (subellipticis).

Dutch New Guinea: 9 km. N. E. of Lake Habbema, alt. 2,800 m, *Brass 10257* (type), *10284;* "Common on ground in rather open mossy forest; fronds variegated green and white."

Clearly distinguished from *G. knutsfordiana* by the long-creeping rhizome and the dense coat of minute, rigid setulae on the lamina; because of these setulae, sticking up through the sorus, I cannot be sure whether or not the sporangia bear any setulae. Brass notes the variegated fronds of both collections, but these do not show on the dried specimens.

Fig. 73

102a. POLYPODIUM FUCIFORME Ros.

Polypodium fuciforme Ros., Nova Guinea 8 (1912) 726.

"*Eupolypodium;* rhizomate breviter repente. ramoso, radiculoso, paleis linearibus aureo-fuscis, flaccidis, 3–4 mm longis dense vestito; stipitibus c. 14 cm. longis, lamina decurrente fere ad basin usque alatis, glaberrimis; laminis e basi cuneata ovalibus, obtusis, e pinnatifido furcato-decompositis, subcoriaceo-chartaceis, flavidis, glaberrimis, ad 17 cm. longis latisque; segmentis primariis alternis, utrinque 4–5 erecto-patentibus, cuneato-ovalibus, obtusis, c. 14 cm. longis, 10 cm. latis, subpinnatifido-dichotomis, summis furcatis vel simplicibus, laciniis ultimis linearilanceolatis, sensim angustatis, acuminatis, 1½–4 cm. longis vix 2 mm. basi latis, rachibus, costis, costulisque anguste alatis, ala rachin cingente c. 2 mm. utrinque lata, secus costas costulasque gradatim angustiore, integerrima; nervis lateralibus (ex rhachi rachillisque orientibus) obliquis, plerisque simplicibus, subparallelis, rarius furcatis, apice vix incrassato ante marginem desinentibus; soris in segmentis ultimis utrinque uniseriatis, dorsalibus, inter costam et marginem medialibus.

"Hab. Nova Guinea neerlandica, in collibus submontanis, c. 750 m.s.m., Nov. 1909, 1. von Roemer no. 846.

"Die aussergewöhnliche, einer monströsen Blattbildung gleichende Gestalt der Lamina lässt einen Vergleich mit einer bekannten Art kaum zu . . ."—Rosenstock, l. c.

102b. POLYPODIUM DICHOTOMUM Brause

Polypodium dichotomum Brause, Engler's Jahrb. **56** (1920) 190, *non* Houttuyn *nec* Thunb.

Reductions of *Polypodium alcicorne* and *P. dichotomum* to *P. fuciforme* are suggested by Christensen, Suppl. III 149. Brause says that *P. fuciforme* is distinguished from *P. dichotomum* by being more divided and with narrower segments, and the descriptions so indicate. He also suggests the identity of *P. alcicorne* and *P. dichotomum,* but leaves this in doubt, wanting a specimen of the former and its description being inadequate. So far as names go, both specific names are invalid.

My only specimen in hand is *Brass 5095,* which is *P. dichotomum* Brause, whether or not it is *P. fuciforme.* Not knowing the latter, and the specimen having no other tenable name, I leave it, following Christensen, "Pol. fuciforme Rosenst., f. dichotoma (Brause)" sched. in Gray Herb.

Rhizome short-creeping, paleae lanceolate, up to 5 mm long, brown; stipe 1 to 3 cm long, winged upward, naked, nigrescent, undivided base of lamina 8 to 10 cm long, above this two segments about 17 cm long, 6 mm wide, subparallel, coriaceous, naked; veins once forked (rarely, twice), both branches reaching nearly to the margin; sori subcostal, above the base of the fertile veinlet, superficial (Brause says impressed), round, receptacle elongate, sporangia naked.

Rather thinner than *G. fasciata,* and the sori rounder and more strictly costal; but ill distinguished from occasional freak forms of that species.

102c. POLYPODIUM ALCICORNE Ridley

Polypodium alcicorne Ridley, Trans. Linn. Soc. Bot. **9** (1916) 261, *non* Baker.

"Planta caespitosa, 20–35 cm. alta, rhizomate crassiusculo squamis pallide brunneis lanceolatis acuminatis tecto. Stipes 10 cm. longus, basi teres, superne complanatus, alatus. Frondes ter vel quater furcatae, glabrae, coriaceae, complanatae, siccae pallidae, segmentes ad basin 4–5 mm. latis, terminalibus 2–2.5 longis, 2 mm. latis, soriferis linearibus apice obtusis angustatis. Sori in seriebus duobus prope costam subremoti, rotundati vel elliptici, atrobrunnei.

"Camp I, 700 ft.; Camps III to VIII, 2500 to 4900 ft.

"Allied to *P. subdichotomum* Rac., of Sumatra, but much more branched and glaborus."—Ridley, l. c. Dutch New Guinea.

The three preceding "species" are all founded on abnormalities in the genus, and may all represent abnormalities in their

species, whatever these species are. As to "die Reihe von *P. dichotomum,*" etc., these should form a series in a catalogue of freaks, but are not one in any other sense. In describing such a specimen, attention is focussed on the abnormal feature, and it is practically impossible, from the description alone, to know what normal species, if any, is represented. It is of course possible that the forking of the frond is so fixed in heredity that it really characterizes a species; but this is not to be concluded, nor presumed, from the collections responsible for these descriptions. I have already commented, in the introduction, on the commonness of this abnormality in *Grammitis.*

COMMENT ON NEW GUINEA GRAMMITIS

The first impression made by this flora is that it is very large; and this is more true than it is possible now to show statistically. The proportion of novelties in recent collections indicates that many are still to be found. Mr. Brass and Mrs. Clemens are excellent collectors, but there are great areas in the high *Grammitis* zone still unseen by any collector. The region is incomparably rich in the genus.

The second impression is that of high endemism, although that is already familiar in the genus. Of 47 species which I have listed as probably distinct, and nearly all of which I know to be so, only five, *G. fasciculata, G. knutsfordiana, G. sumatrana, G. subrepanda* and *G. dolichosora* are known elsewhere, the first and third all over Malaya, the others as far as Borneo. If, however, groups instead of species be considered, the resemblance between the floras of New Guinea and Malaya will be found much greater.

The apparently complete specific discontinuity toward the East is the more remarkable because in most other similarly large fern genera there are enough species ranging from Malaya to Polynesia to indicate considerable freedom of migration in at least one direction. It is possible that when the flora of the intervening islands, particularly of Bougainville because of its altitude, is better known, this break will not be as complete as it now appears. A considerable part of the Polynesian species are without even group relatives in New Guinea.

No New Guinea species known to me shows anything nearer than generic affinity to the group of *G. Billardieri. G. ciliolata* is like *G. ciliata* in several respects, but the setulose sporangia relate it to its neighbors, in complete distinction to the flora of the far South.

The sporangia of almost all New Guinea species are setulose or setose. This is so far true as to make it seem probable that the bristles have been lost hereditarily by such species as *G. graminifolia* and *G. integra*, which are quite positively without them. A conspicuous and distinctive general feature of the genus in New Guinea is the number of species with elongate rhizomes. In all other regions, species with remote stipes are conspicuous exceptions, but in New Guinea they are common.

An element of some importance contributing to New Guinea's wealth of species is their commonness at great altitudes, even above 3,000 meters. It is of course true that Malaya and Polynesia have comparatively very small areas at such heights. But it is also true that *Grammitis* is almost wanting at the tops of their highest mountains, unreported in the grass on Pulog and the heath on Apo, formations in which it seems to be common in New Guinea.

THE MALAY—ASIATIC SPECIES

In the study of the species of this part of the World, the first step has had to be to establish the identity of Blume's species. Some of these have been well known; some effectively unknown since Blume's time; some misconstrued. Thanks to the kindness of Director Lam, I can now fix the nature and place of most of them. It would have been more convenient to make the order of study the order of presentation as well, beginning with Java, and following with the next longest and best known area, the Philippines; for the study of a little known land, New Guinea, is not a convenient introduction to that of lands much better known. However, I have preferred to follow the order of nature, at least in this respect, letting the presentation of the New Guinea species precede that of lands I regard confidently as colonized from New Guinea.

Because of the number of species, and because they are well represented in herbaria, I present keys to the species of Java and the Philippines, besides one to those of the whole region.

Key to the Malay-Asiatic species

Stipes or frond-bases glabrous.
  Fronds large (15 cm or more), coriaceous.
    Sori superficial or nearly so.
      Sori uniseriate, margin entire.
        Sporangia naked ..... 103. *G. fasciata*

Sporangia setulose.
Paleae ovate-lanceolate ..... 104. *G. padangensis*
Paleae narrowly lanceolate..... 105. *G. ceramica* (Ceram)
Some sori scattered, margin irregular 106. *G. loheriana* (Luzon)
Sori deeply impressed ..... 134. *G. cavisora* (Borneo)
Fronds small.
Herbaceous to subcoriaceous ..... 107. *G. adspersa*
Coriaceous.
Frond glabrous ..... 108. *G. kinabaluensis* (Borneo)
Hairs present among sori ..... 109. *G. universa*
Stipe minutely and laxly pubescent..... 107. *G. adspersa*
Stipe short-velutinous.
Sori deeply immersed ..... 110. *G. caespitosa*
Sori not deeply immersed.
Veins once forked.
Pubescence sparse ..... 129. *G. attenuata*
Pubescence dense, very short..... 122. *G. peninsularis* (Peninsula)
Veins forked more than once.
Surface of lamina naked.
Sori rather scattered ..... 74. *G. sumatrana*
Sori regularly seriate ..... 75. *G. subrepanda*
Surface more or less pubescent.
Hairs not very minute.
Hairs all solitary..... 112. *G. congener*
Marginal hairs partly tufted..... 113. *G. Fenicis*
Hairs all minute ..... 114. *G. microtricha* (Mindanao)
Stipe hairy, hairs over 0.6 mm long.
Frond forked ..... 102. *G. subdichotomum* (Sumatra)
Frond not normally forked, sori immersed.
Hair-bases enlarged.
Stipe very rough ..... 115. *G. limapes* (Java)
Stipe slightly rough ..... 116. *G. bulbotricha* (Luzon)
Hair-bases not enlarged, frond minute 117. *G. Merrillii*
Hair-bases not enlarged, frond at lease 3 cm long.
Marginal hairs in part tufted.
Hairs nigrescent ..... 118. *G. jagoriana*
Hairs not nigrescent ..... 113. *G. Fenicis*
Marginal hairs solitary.
Veins normally once forked.
Sori costal to medial.
Fertile veinlet regularly elongate.
Lamina pubescent.
Hairs under 2 mm long 119. *G. hirtella*

Hairs 3 mm long ..... 121. *G. Holttumii* (Peninsula)
Lamina naked or glarescent.
Stipe short or none ..... 127. *P. Kjellbergii* (Celebes)
Stipe at least 2 cm long 120. *G. ludens*
Fertile veinlet casually elongate 126. *G. Asahinae*
Fertile veinlet not elongate.
Veins conspicuous ..... 128. *G. Reinwardtii*
Veins inconspicuous.
Marginal hairs 3 mm long 123. *G. bongoensis* (Borneo)
Marginal hairs shorter.
Frond ca. 0 cm long ..... 124. *G. reinwardtioides* (Borneo)
Frond ca. 8 cm long.
Stipe densely hairy ..... 125. *G. dorsipila*
Stipe sparsely hairy ..... 126. *G. Asahinae*
Sori medial to submarginal.
Frond narrowly lanceolate ..... 130. *G. zeylanica* (Ceylon)
Frond elliptic-lanceolate ..... 131. *G. Wallii* (Ceylon)
Veins commonly twice forked.
Frond subcoriaceous to coriaceous.
Margin setose.
Stipe fairly densely setose.
Laminar setae sparse ..... 132. *G. setosa*
Lamina setae many ..... 135. *G. nigrosetosa* (Buru)
Stipe shaggy-setose ..... 136. *G. Stresemannii* (Ceram)
Margin minutely setulose.
Venation salient ..... 100. *G. knutsfordiana*
Venation inconspicuous.
Sori-short-oblong ..... 137. *G. obscura*
Sori long-elliptic ..... 82. *G. dolichosora*
Frond herbaceous to spongy.
Stipe about 2 cm long ..... 138. *G. marivelesensis* (Luzon)
Stipe commonly 5 cm long ..... 98. *G. fasciculata*
Veins forked more than twice.
Sori strictly uniseriate ..... 98. *D. fasciculata*
Sori becoming pluriseriate.
Paleae entire or obsolescent.
Pubescence sparse, dark ..... 139. *G. pilosiuscula*
Pubescence dense ..... 140. *G. Havilandii* (Borneo)
Paleae ciliate.
Frond lanceolate ..... 141. *G. Frederici et Pauli* (Celebes)
Frond linear-elliptic ..... 142. *G. calcipunctata* (Borneo)

Key to Java species

Sori deeply immersed.
- Stipe velutinous ..... 110. *G. caespitosa*
- Stipe sparsely hirsute ..... 111. *G. stenocrypta*

Sori not deeply immersed.
- Stipe naked.
  - Frond over 15 cm long, coriaceous.
    - Margin naked ..... 103. *G. fasciata*
    - Margin bearing black bristles ..... 104. *G. padangensis*
  - Frond small and thinner ..... 107. *G. adspersa*
- Stipe short-velutinous.
  - Lamina more or less pubescent ..... 112. *G. congener*
  - Naked unless for costa and margin..... 74. *G. sumatrana*
- Stipe bearing sparse very short hairs..... 107. *G. adspersa*
- Stipe bearing hairs over 0.5 mm long.
  - Hairs with enlarged bases ..... 115. *G. limapes*
  - Hairs without enlarged bases.
    - Veins normally once forked.
      - Fertile veinlet elongate, sori dorsal.
        - Frond freely pubescent ..... 119. *G. hirtella*
        - Frond glabrescent ..... 120. *G. ludens*
      - Fertile veinlet short.
        - Veins evident ..... 128. *G. Reinwardtii*
        - Veins immersed ..... 229. *P. lasiosorum*
    - Veins commonly twice forked.
      - Margin setose ..... 132. *G. setosa*
      - Margin minutely setulose ..... 137. *G. obscura*
    - Veins forked more than twice.
      - Sori strictly uniseriate..... 98. *G. fasciculata*
      - Sori becoming pluriseriate ..... 139. *G. pilosiuscula*

Key to Philippine species

Sori deeply immersed.
- Stipe velutinous ..... 110. *G. caespitosa*
- Stipe sparsely hirsute ..... 111. *G. stenocrypta*

Sori not deeply immersed.
- Stipe naked.
  - Fronds at least 15 cm long, coriaceous.
    - Margin entire, sori uniseriate.
      - Sporangia naked ..... 103. *G. fasciata*
      - Sporangia setulose ..... 104. *G. padangensis*
    - Margin irregular ..... 106. *G. loheriana*
  - Frond smaller and thinner ..... 107. *G. adspersa*
- Stipe bearing short, not dense hairs ..... 107. *G. adspersa*
- Stipe short-velutinous.
  - Lamina more or less pubescent.
    - Marginal hairs solitary, not minute 112. *G. congener*
    - Longer marginal hairs tufted ..... 113. *G. Fenicis*
    - Hairs of lamina all minute ..... 114. *G. microtricha*
  - Lamina, unless costa and margin, naked 74. *G. sumatrana*

Stipe not velutinous, hairs over 0.5 mm long.
Hairs with enlarged bases ..... 116. *G. bulbotricha*
Hairs without enlarged bases.
Frond minute ..... 117. *G. Merrillii*
Fronds at least 3 cm long.
Marginal hairs more or less tufted.
Hairs nigrescent ..... 118. *G. jagoriana*
Hairs not nigrescent ..... 113. *G. Fenicis*
Marginal hairs solitary.
Frond more or less coriaceous.
Veins immersed ..... 82. *G. dolichosora*
Veins evident, inconspicuous ..... 132. *G. setosa*
Venation conspicuous ..... 100. *G. knutsfordiana*
Frond rather herbaceous.
Veins mostly once forked ..... 128. *G. Reinwardtii*
Veins forked more than once.
Stipe under 2 cm long ..... 138. *G. marivelesensis*
Stipe over 2 cm long ..... 98. *G. fasciculata*

102. POLYPODIUM SUBDICHOTOMUM Racib.

Polypodium subdichotomum Racib., Dept. Agri. N. I. Bull. No. 18 (1908) 20; No. 21, *pl. 3.*

"Tota planta pilis longis, squarrosis, rubrofuscis vestita. Rhizoma breve, paleis membranaceis, ferrugineis, subsubulatis, integris dense vestitum. Stipites fasciculati vel approximati, breves. Frondes coriaceae, 10–15 c.m. longae, basi sensim angustatae; frondes adultae 2-furcatae, laciniis simplicibus vel iterum furcatis. Segmenta linearia, 2–3 m.m. lata, apice sensim angustata, venis occultis, liberis, brevibus, furcatis. Sori utroque latere costarum 1-seriales, subcostales, rotundati, magni, alternantes, demum fere confluentes et superficiem inferam segmentorum fere totam occupantes.

"Sumatra (Forbes, Nos. 2408 & 2497)."—Raciborski, msc. (1908).

Comment on these apparent freaks has been presented in connection with Nos. 102a to 102c, at the end of the New Guinea species.

103. GRAMMITIS FASCIATA Blume

Grammitis fasciata Blume, Enum. (1828) 116; Flora Javae 117, *pl. 49, fig. 1.*

Polypodium fasciatum Presl, Tent. (1836) 180, and of all recent authors.

"G. frondibus stipitatis elongato-lineari-lanceolatis utrinque acuminatis subintegerrimis coriaceis subaveniis ad marginem supra seriatim punctatis stipitibusque glabris, soris ellipticis subobliquis, caudice repente.

"Obs. A priori (G. rubinervis) recedit frondibus longioribus glabris et ad marginem punctatis.

"Crescit in Javae monte vulcanico Gede, regionibus temperatis."—Blume, Enum.

Herb. Lugd. Bat. sheet No. *908,300. . . 587* is the proper type of this species, bearing Blume's autograph label, and specifically from Kandang Badak, the more exact source stated in Flora Javae. In the same herbarium are several other sheets apparently of the same collection. Isotype in Herb. N. Y. Bot. Garden.

FIG. 74

Rhizome creeping, usually terrestrial, woody, 1.5 to 2 mm thick; paleae up to 3 mm long, ovate, acute, brown, firm, appressed: stipes more or less 1 cm apart, erect, up to 10 cm long, about 1 mm thick, almost black, naked; lamina 30 to 40 cm long, about 9 mm wide, attenuate to both ends, entire, coriaceous, brown, glabrous except for a few bent black marginal setulae present on the type and on a minority of other collections; costa prominent beneath, veins invisible or visible on either or both surfaces, forked near the costa, the basiscopic veinlet forked again in the broader part of the frond, both veinlets casually forked again, anastomoses very rare, veinlets ending under submarginal hydathodes; sori dorsal on the acroscopic veinlets in the upper part of the frond, subcostal, large, oblong, oblique to the costa, superficial, sporangia naked.

A curiously misnamed, conspicuous, much collected species, very distinct, and free of synonyms. Of such, Backer and Posthumus, Varenflora voor Java (1939) 202, cite three: *Catenularia coriacea* Zippel, an herbarium name; *Grammitis stenocrypta,* which is not this species nor very close to it; and *G. longa* Fée, which is described as "Filix fasciculata, . . . frondibus repandis, . . . stipite brevi, filiformi; lamina grabriusc[illegible]; sporotheciis supra impressis, . . . sporangiis sacculo piloso," none of which items describe this species.

JAVA: two dozen sheets in Herb. Lugd. Bat. and others in other herbaria, very uniform except for stunted individuals, and all, so far as labels show locality, from the Gedeh or Panggranggo (two summits of one mountain mass; Kandang Badak is under the saddle connecting them). Raciborski, Pteridophyten der Flora von Buitenzorg (1898) 88, cites also Goemoeroe.

BORNEO: seventeen collections from Kinabalu. Of these, *Clemens 30523* and *33742* have narrow fronds, 5 to 6 mm wide, and some appressed marginal setae; I have detected no anas-

tomosis of their veins. Several specimens have irregularly, shallowly crenate margins.

PHILIPPINES: Mt. Apo, *Elmer 10636 A;* Mt. Pulog, *Bur. Sci. 44983, 45010 Ramos* and *Edaño;* Pauai, *Mearns 4204, Copeland 1947;* Mt. Data, *Copeland s. n.* All Luzon specimens are smaller and narrower than Javan, and the two of my own collection bear marginal setulae, like those from Borneo already mentioned, and like *G. graminifolia.*

104. GRAMMITIS PADANGENSIS (Baker) Copel., comb. nov.

Polypodium padangense Baker, Jour. Bot. **18** (1890) 213; Holttum and Christensen, Gardens' Bull. **7** (1934) 293.
P. durum Copel., Elmer's Leaflets Philip. Bot. **3** (1910) 837.
P. ciliiferum v.A.v.R., Bull. Buit. **II** No. 16 (1914) 32.
P. planum v.A.v.R., *ibidem.*
P. adspersum Backer and Posthumus, Varenflora, 203, *non* Blume.

"Rhizome short-creeping, epigaeous, one-fifth to one-sixth in diam., clothed with densely imbricated large pale brown lanceolate membranous scales. Stipe almost obsolete. Lamina ligulate, entire, ½ foot long, 4–5 lines broad at the middle, narrowed gradually to the base, very thick and coriaceous in texture, almost naked on both sides, but the edge ciliated with a very few minute black hairs. Veins forked, free. Sori orbicular, slightly immersed, placed in a single row near the thick midrib in the upper half of the frond a short space from one another. Mt. Singalan, 1700 meters. Near the Ceylonese *P. zeylanicum,* Mett."—Baker, l. c. (Sumatra, *1. Beccari*).

The reductions of *P. durum* and *P. ciliiferum* are by Christensen, who had seen the three types. The types of *P. padangense* and *P. planum* are from the same Sumatra mountain; and the description of the latter fits almost perfectly the type of *P. durum* as it now is, destitute of the marginal setae present when it was described.

FIG. 75

Paleae 2 to 7 (!) mm long, the shorter ones ovate rather than lanceolate, very light brown; veins mostly invisible without preparation, forked somewhat above the base, fertile veinlet prolonged beyond the sorus almost to the margin; basiscopic veinlet often forked again near the margin; sori large, up to 4 mm across on the type of *P. durum;* sporangia setuliferous.

A relative of *G. fasciata,* more coriaceous and opaque, sessile or short-stipitate, with setuliferous sporangia.

JAVA, in Herb. Lugd. Bat. without data. Sumbawa, *Zollinger 1577.* BORNEO: Mt. Kinabalu, *Clemens 27997.* PHIL-

IPPINES: Mt. Apo, *Elmer 11689* (type of *P. durum*); Camiguin de Mindanao, *Bur. Sci. 14831 Ramos.*

105. GRAMMITIS CERAMICA (v.A.v.R.) Copel., comb. nov.

Polypodium ceramicum v.A.v.R., Bull. Buit. III 2 (1920) 168.

"*Eupolypodium, Integrifolia.*—Rhizoma repens; squamae anguste lanceolatae, integerrimae, pallide brunneae. Stipites seriati, ½–1 cm. longi, castanei, glabri, teretes. Frondes coriaceae, glabrae, lineari-oblanceolatae, 20–30 cm. longae et 6–9 mm. latae, apice obtusiusculae, margine integerrimae et auguste recurvatae, parte inferiore anguste lineari-cuneatae, costa supra sulcata, subtus prominens; venae absconditae, plus minusve patentes, furcatae vel subpinnatae; venulae marginem frondis fere attingentes; sori relative magni, utrinque 1-seriati, subcostales, ad basin venularum anticarum positi, vix immersi, suboblongi, demum contigui et specie costales; capsulae castaneo-setosae.

"Lime stone, in forest; alt. 1900–2500 m.

"Ceram (Mt. Moerkele; L. Rutten's Explor. Commiss., Coll. Kornassi No. 1505, 1 July 1918".—v.A.v.R., l. c.

Isotypes in the Leiden and Manila herbaria consist of eight very uniform plants. In the short-creeping rhizome, color of paleae, short stipe, texture, pattern of venation, position of sori, and setulose sporangia, this is identical with *G. padangensis.* The fronds of *G. ceramica,* as seen, are glabrous and nonciliate; but so are now those of the type of *Polypodium durum,* which I described when they were comparatively fresh as "fere glabrae." Casual anastomosis of the veinlets is observed in both species. The sole definable difference is in the form of the paleae, which reach an extreme length of 7 mm in both species, but are only about half as broad in *G. ceramica* as in *G. padangensis,* rather narrowly lanceolate instead of ovate-lanceolate. This difference seems to be constant.

FIG. 76

106. GRAMMITIS LOHERIANA (Christ) Copel., comb. nov.

Polypodium loherianum Christ, Bull. Boiss. 6 (1898) 197, *pl. 3 fig. 2.*

"Rhizomate brevi, radices filiformes pilis purpureis vestitas emittente, frondibus quinis aut senis fasciculatis, stipite 1–3 cm. longo rufo laevi uti tota planta, fronde ligulato-lanceolata 15 cm. longa ¾–1 cm. lata sensim ad stipitem decurrente apice obtusiusculo, margine dentato-crenato dentibus in eadem fronde varie longitudinis obtusis triangularibus usque ad 3 mm. longis. Costa nervisque inconspicuis sed luce transeunte distinctissimis nigris liberis in lobo pinnatis, duobus raris utroque latere instructis, soro ramulo infimo brevi lateris superioris et quidem infra nervi apicem inserto, vix immerso rotundo seu ovali, mediali, brunneo. Soris uniseriatis, ramo altera serie secus nervos exteriores prostante.

"Textura suberoso-coriacea colore pallide viridi.

"Species ob marginis serraturam et sororum positionem infra nervi apicem peculiari.

"Hab. Monte Data 2250 m., III, 1897."—Christ, l. c.

Rhizome creeping, stout, paleae commonly 3 mm, rarely 4 mm long, ovate or sometimes narrower, thin, dark-slate-colored; stipes seriate but not remote, up to a millimeter in diameter; lamina commonly 15 cm, sometimes 25 cm long, about 1 cm wide, or widened by projecting lobes, broadly crenate, sinuate, or variously toothed or with projections, attenuate at base, sometimes prolonged as a lateral line to the base of the stipe, coriaceous, naked; veins immersed, several times forked, the lowest acropetal branch and sometimes one or more of the others fertile; sori terminal on their veins and well above their bases, superficial, oblong to round, large, forming an inframedial row on small fronds, with additional scattered, smaller sori on large fronds; sporangia naked except for very sparse, caducous ferruginous setulae.

FIG. 77

Common, epiphytic and terrestrial, in the Mountain Province of Northern Luzon, altitude 2,000 to 2,500 m. *Copeland 1867, For. Bur. 16002 Bacani* and *Clemens 18698,* Mt. Data, topotypic; *Copeland P. P. E. 143, Merrill P. P. 973, For. Bur. 4975 Curran, Topping 310, Williams 1562, Vanoverbergh 941 P. N. H. 3969 Celestino, Castro and Añonuevo.*

There are two collections, *Merrill 7721* and *Bur. Sci. 40454,* with longer and more regular marginal outgrowths, making the frond subregularly lobato-pinnatified, and with sparsely pilose stipes. They are obvious relatives of the plant identified for me by Christ as his *Polypodium decrescens,* and I believe them to be hybrids of the two species; both assumed parents are locally fairly common.

G. loheriana is a relative of *G. fasciata,* distinguished by repeatedly forked veins and correlated unevenness or instability of margin; the frond is as thick, but not so firm in texture. I do not find any intergradations. *G. loheriana* might be an established hybrid of *G. fasciata* and *P. decrescens.*

107. GRAMMITIS ADSPERSA Blume

Grammitis adspersa Blume, Flora Javae (1829) 115, *pl. 48, fig. 2.*
Polypodium adspersum Blume, Enum. (1828) 123.

P. sessilifolium Hooker, Sp. Fil. **IV** (1863) 168, *pl.* 268 *A;* Beddome, Ferns Brit. India, *pl. 119, non* Liebmann.
Grammitis sessilifolia J. Smith, Hist. Fil. (1875) 181.
Polypodium subevenosum Baker, Syn. Fil. (1867) 320; Christensen, Gardens' Bull. **4** (1929) 402.
P. Maxwellii Baker, Kew Bull. (1893) 211.
P. paucisorum Copel., Philip. Jour. Sci. 2C (1907) 137, *pl. 3B.*
P. Malaicum v.A.v.R., Malayan Ferns (1909) 577; Christensen and Holttum, Garden's Bull. **7** (1934) 292; Holttum, Gardens' Bull. **9** (1937) 134.

"P. frondibus subsessilibus linearibus obtusis basi attenuatis subrepandis coriaceis glabris subaveniis sparse nigro-punctatis, soris solitariis costae approximatis, caudice repente squamoso."—Blume, Enumeratio.

"Caudex repens . . . Squamae arctissime imbricatae, ovato-oblongae, acuminatae, integerrimae, ochraceae, membranaceae, arcte reticulatae, deciduae.

"Frondes . . . 2–5–pollicares, ¼–⅓ unc. latae, stipite aut nullo aut brevissimo, complanato, glabro, . . . obtusae, basi angustatae, sub-repandae, venulis lateralibus obsoletissimis, furcatis, marginem non attigentibus, coriaceae, utrinque glabrae.

"Sori juxta costam . . . dispositi, discreti, singuli ramo breviori venae furcatae insidentes; juniores oblongi, puberuli, . . . aetate rotundi, . . . post capsularum interdum setigerarum lapsum depressiones planas in locis insertionis relinquentes."—Flora Javae.

This is a better description than its more familiar successors, and accurately anticipated such epithets as *sessilifolium* and *subevenosum.* The type, Herb. Lugd. Bat. sheet No. *908, 302 . . . 90,* has an elongate, ascending rhizome, and paleae up to 3.5 mm long. There is another sheet bearing a single frond with Blume's label; and a sheet collected on Mt. Salak in 1860, exactly like my own collection on Gedeh in 1915, both of these indistinguishable from some Peninsular and Philippine specimens. As a rule, the rhizome and paleae are shorter than on the type, but there is no ground for doubt as to the specific identity.

Rhizome short and more or less erect, paleae dense, ca. 2 mm long, lanceolate, attenuate to the tip, stramineous to brown; stipes none or very short, usually naked, sometimes bearing short, rather deciduous fibrils; lamina linear, up to 17 cm long and 6 mm wide, attenuate to both ends but apex rounded, entire or more commonly sinuate-crenulate, glabrous, herbaceous or subcoriaceous; veins visible by transmited light, the sterile simple or more commonly

Fig. 78

furcate where the frond is not too narrow, the branches subequal; sori inframedial, basal or dorsal on the fertile veinlet, superficial or little or much impressed and often marked by elevations on the upper surface, receptacles elongate, mature sori round or oblong, sporangia naked or setulose.

As here construed and redefined, this is an exceptionally variable species. As to the reductions to synonymy, Baker imperfectly redescribed *G. adspersa* as *P. subevenosum*, with a clear error in calling the veins simple. *P. sessilifolium* was invalid when published, and *P. malaicum* is a substitute name. Holttum (1937) has shown that Hooker's citations, except for a dubious one of Blume, apply to *P. subevenosum;* but that Hooker's figure is that of an uncited Luzon plant, *Cuming 222* in Hooker's herbarium (the number includes several species). Holttum tried to distinguish *P. sessilifolium* as a larger plant, with most of the veins forked, and possibly by setose sporangia. Size and forking of veins are correlated. I have not seen a frond 9 inches long (Hooker's description reads "3–8–9 inches"), nor quite 8; but find no open gap in a series from 2 to 7 inches in length. As to the sporangia, I have examined a score of collections bearing maturing sporangia, and find them in three more or less equal groups,—those with no setae, those with very few, and those with the sporangia freely setulose, and this grouping is not geographic, nor associated with any other character. I feel sure that these two "species" are in no respect distinguishable. *P. Maxwellii* has already been reduced by Christensen, and I find the identity complete.

Polypodium paucisorum is peculiar in having few, widely separated large sori. Its impressed sori, prominent on the upper surface, appealed to me forty years ago as another distinction, but I find them now on plants which are otherwise clearly *G. adspersa.* The plant still looks different; but its distinctness needs to be authenticated by new collections before it seems expedient to retain it as a species.

An aberrant strain with distinct, minutely pubescent stipes 3 to 5 mm long, ribbon-shaped fronds with finely crenulate, over-full margins, prominent costa, impressed sori, and naked sporangia ranges from Sibuyan to Borneo;—Sibuyan, *Elmer 12511;* Palawan, *Elmer 12314, Bur. Sci. 77974 Edaño, For. Bur. 3894 Curran;* Sarawak, *Brooks 116, Foxworthy 224.* I have described it as distinct, but not published it, as each

of its peculiarities is duplicated by some collection clearly referable to *G. adspersa.*

Christensen proposed in 1929 to reduce *G. kinabaluensis,* but decided in 1934 to hold it distinct; they are at any rate nearly related. *G. brevipila* is another related species.

JAVA: specimens already cited. Malay Peninsula, apparently common: *Hallett 822, Curtis 588, Ridley 7134, King's collector 1560, Holttum 10677, 18255, 18944, 21599, Haniff 9116,* and unnumbered collections by Scortechini and others. ANNAM: *Pételot 3537.* BORNEO: *Hose (G. F. S. & S),* the type collection of *P. Maxwellii, Clemens 33739 partim, Holttum 25479.* PHILIPPINES: Northern Luzon, *Copeland 1856, 1960, 2311, P. P. E. 141, Merrill P. P. 973, Clemens 9193, For. Bur. 16294, 16300 Curran, Merritt* and *Zschokke, Bur. Sci. 31959 Santos, 33252 Ramos;* Central Luzon, *Williams 783, Copeland 2133, Merrill 8022, Bur. Sci. 2392 Foxworthy, Bur. For. 7963;* Mindoro, *Merrill 5964* (type of *P. paucisorum*); Negros, *Merrill 6960.* Not reported from Mindanao, nor Sumatra.

108. GRAMMITIS KINABALUENSIS Copel.

G. kinabaluensis Copel., Philip. Jour. Sci. **56** (1935) 479.
Polypodium kinabaluense Copel., Philip. Jour. Sci. **12C** (1917) 60.

"Grammitis minuta, rhizomate erecto, apice paleis pallidis minutis lanceolatis vestito; stipitibus permultis confertis, usque and 5 cm longis castaneis, glabris, erectis; frondibus lineari-oblanceolatis, 3 ad 5 cm altis, 2.5 ad 4 mm latis, obtusis, deorsum sensim angustatis, glabris tenuiter coriaceis; venis furcatis ramis subaequalibus, ramo superiore apud furcam sorifero; soris superficialibus vel levissime immersis, vix elongatis.

"Mt. Kinabalu, altitude 3,700 meters, *Mrs. Clemens 10649* (type), *10618 partim.*

"A very distinct little fern of the Alpine summit."—Copeland, l. c.

Paleae 1 to 1.5 mm long, ferruginous; stipes mostly about 2 cm long; veins furcate well away from the costa; sori therefore about medial, superficial or evidently impressed. Christensen and Holtum, Gardens' Bull. 7 (1934) 292, call attention to the red-brown setae on the sporangia; these are short, and at just the right stage, abundant, but so caducous that they may be conspicuous near the tip of a frond, and entirely gone farther down on it.

FIG. 79

Local near the summit of Kinabalu. Christensen and Holttum cite seven collections, to which *Clemens 51111, 51389,*

and *51393* can be added. It is the dwarfed Alpine vicar of *G. adspersa.*

109. GRAMMITIS UNIVERSA (Baker) Copel., comb. nov.

Polypodium universe Baker, Annals Bot. 5 (1891) 464.
P. minimum Baker, Jour. Bot. 17 (1879) 41, *nec aliorum.*
P. vittariifolium C. Chr., Index (1906) 574.

"Densely tufted. Fronds simple, sessile, rigidly coriaceous, linear, 1½–2 in. long, 1/12–⅛ in. broad above the middle, narrowed gradually to the base, furnished with deciduous brown hairs. Midrib distinct; veins immersed, hidden. Sori oblong, crowded, uniseriate, confined to the upper part of the frond, where they fill up the whole space between the midrib and margin. Penang, *Curtis,* 633. Habit of *P. linearifolium,* Hook."—Baker, l. c.

This is represented by 15 collections in the Singapore Herbarium, including 2 by Curtis, but not the original.

Rhizome ascending, small, paleae 1 to 1.5 mm long, broadly lanceolate, fuscous; stipes 0 to 10 mm long, black, naked; lamina commonly 3, sometimes 5 cm long, 2 mm wide, entire sinuate or crenulate, obtuse, narrowing from near the apex to a long-attenuate base, fertile in the broader upper third or half, and the nether surface there bearing atro-fuscous setae up to 0.8 mm long but mostly shorter, coriaceous and very opaque; costa sinuate in the fertile part of the frond; veins at an acute angle, once forked, the basiscopic branch approaching the margin, the fertile one parallel to the axis of the frond, occupied by the long receptacle, sori becoming roundish and covering the entire surface, sporangia naked.

Penang, Perak, Pahang, Johore, "Malay Peninsula," nos. *75, 7729, 15004, 16203, 19783, 20087, 31717, Seimond 414, 428, 431.* Only Nos. *19783, 20087, 31717, 1. Holttum,* seen except in the Singapore Herbarium; Borneo, Sarawak, Mt. Gadang, *G. F. S. & S.* (Geo. F. Hose, Bishop of Singapore and Sarawak); Summit of Kinabalu, *Clemens 27783* (?).

A plant of low country, on rocks along streams, in shade. Isolated in the genus as to its habitat; probably related to *G. adspersa.* Baker invented an adjective of the third delension as his specific name; assuming that he did this in error, I have corrected it.

The reduction of *P. vittariifolium* C. Chr., is based on the collection by Bishop Hose from Mt. Gadang, labelled "Polypodium minimum Baker n. sp.," in Herb. Singapore. It is not really as authentic as the label would indicate, but I have

confidence in the identification. It is exactly *G. universa.* Bishop Hose recognized the identity, as shown by a note in the same herbarium on a Peninsular specimen of *G. universa.*

110. GRAMMITIS CAESPITOSA Blume

Grammitis caespitosa Blume, Enum. (1828) 115; Flora Javae II 106, *pl. 46, fig. 1.*

Polypodium caespitosum Mett., Ann. Lugd. Bat. 2 (1866) 219.

"G. frondibus stipitatis linearibus obtusiusculis integerrimis glabris coriaceis aveniis margine recurvis, soris ellipticis subobliquis, stipite scabro, caudice caespitoso.

"Obs. A. *G. lineari* Sw. differt fronde obtusiuscula, avenia."—Blume, Enumeratio.

The long description in Flora Javae includes: "Stipes circiter ½-pollicaris, filiformis, teres, ecanaliculatus, pilis parvis multis fuscis hirtellus . . . Frondes . . . bi-pollicares, vel paululum longiores, vix 2 lin. latae . . . Sori . . . profunde immersi, unde frons supra leviter tuberculata."

The sole Java specimen in hand is *Clemens 30524,* from Mt. Gedeh, alt. 7,000 feet, in my own herbarium. It conforms exactly to the description, to which it may be added that the paleae are densely imbricate, 3 mm long, lanceolate, obtuse, yellowish-brown darkening to fuscous. The stipes are up to 2.5 cm long, densely velutinous with setulae hardly 0.2 mm long. The fronds are singularly coriaceous for so small a fern, the margins all deflexed or rolling backward. The once-forked veins are inconspicuous even after clearing the frond. The sori are medial, deeply immersed, elongate at maturity. Sporangia bearing short, dark, caducous setulae.

The pubescence of the stipe is approximately duplicated by that of *G. brevipila* of Luzon, and *G. sumatrana.* The only other known Java species with deeply immersed sori is *G. stenocrypta,* but several New Guinea species are like it in this respect. No other species has a similarly velutinous stipe and deeply immersed sori.

I have single plants of *G. caespitosa* from Mt. Pulog and Mt. Data in Luzon; and it is *Copeland 1010 partim* and *1008 partim* from Mt. Apo in Mindanao. So far as known, it has been collected only on these mountains and on Mt. Gedeh, and is rare in these localities. Previous reports of it from Luzon and from Mt. Kinabalu in Borneo have been based on the species which I now distinguish as *G. stenocrypta,* with long stipes bearing sparse deciduous hairs.

111. GRAMMITIS STENOCRYPTA Copel.

Grammitis stenocrypta Copel., Philip. Jour. Sci. 46 (1931) 220.
Polypodium stenocryptum C. Chr., Suppl. III (1934) 159.

"G. fasciatae similis, paleis angustis et soris profunde immersis costa remotis facile distinguenda, rhizomate brevirepente, 1.5 mm crasso, paleis ferrugineis 4 mm longis 1 mm latis dense vestito; stipitibus approximatis, 6–7 cm longis, 0.6–0.7 mm crassis, pilis paucis debilibus deciduis aspersis, basi nigro bulboso paleis rhizomatis immerso articulatis; fronde lineare, 20 cm longa, 7–8 mm lata, utrinque attenuata sed apice ipsa obtusiuscula, integra, coriacea, inferne praecipue ad costam pilis obscuris vix 1 mm longis mox omnibus caducis vestita deinde glabra; costa manifesta vix prominente; venis plerisque furcatis, ramo inferiore rarius iterum furcato, ramis in hydathodis inconspicuis terminantibus; soris inframedialibus, prima apparitione in cryptis 2.5–3, rarius usque ad 4, mm longis linearibus immersis, deinde sporangiis evolutis ellipticis oblique positis, sporangiis setis brevibus protectis.

"Java, Gedeh, prope Kandang Badak, *Copeland,* May, 1915.

"At first sight, much like *G. fasciata,* and perhaps in the past confused with that species. Too naked for confusion with *G. setosa* or *G. rubinervia,* longer stalked with longer sori, farther from the costa. *Grammitis longa* Fée can hardly be *G. fasciata,* as it has been construed, because *G. fasciata* is remarkable for its naked fronds and sporangia. The description of *G. longa,* 6th. Mémoire, page 6, plate 4, fig. 1., is far inferior to its author's usual standard; it appears to differ from *G. stenocrypta* by having shorter stipes, more divergent and mostly twice forked sterile veinlets and the sori shorter, more costal and more nearly parallel to the costa."—Copeland, l. c.

Backer and Posthumus, Varenflora voor Java (1939) 202, reduce this to *G. fasciata,* perhaps because of the superficial resemblance to which I called attention; they are not near relatives. The nearer affinity is to *G. caespitosa,* from which it is distinguished by long stipes bearing sparse weak hairs more than 1 mm long, better than by the long, narrow slits in which the sori are borne.

FIG. 80

To this species I now refer the Luzon plant distributed as *Polypodium caespitosum, For. Bur. 16299, Merrill 6388, Copeland P. P. E. 135* (mostly; individuals of three other species got into this distribution;) also the plant from Mt. Kinabalu, Borneo, *Holttum 25496,* Gardens' Bull. 7 (1934) 293, named *P. caespitosum* with observation of the difference. The plants of Borneo and Luzon are smaller than the type, and the of Borneo and Luzon are smaller than the type, and the pubescence is shorter and more fugitive, but of the same weak type.

112. GRAMMITIS CONGENER Blume

G. congener Blume, Enum. (1828) 115; Flora Javae 108, *pl. 46, fig. 8.*
Polypodium congenerum Presl, Tent. (1836) 180.
Grammitis brevipila Copel., Brittonia 1 (1931) 69, *pl. 2.*
Polypodium brevipilum C. Chr., Suppl. III (1934) 145.
Grammitis duplopilosa Copel., Brittonia 1 (1931) 69, *pl. 3.*
Polypodium duplopilosum C. Chr., Suppl. III (1934) 148.
Grammitis petrophila Copel., Philip. Jour. Sci. **56** (1935) 478, *pl. 9.*

"G. frondibus stipitatis elongato-linearibus utrinque attenuatis integer rimis coriaceis aveniis margine recurvis subtus stipiteque puberulis, soris rotundato-ellipticis costae parallelis, caudice repente.

"Obs. A priori (G. pilosiuscula) differt frondibus elongatis tantummodo subtus puberulis atque soris magis approximatis.

"Crescit in Javae arboribus parasitica."—Blume, Enum.

"Stipes ½–1-pollicaris et longior, filiformis, ecaniculatus, pilis vestitus brevioribus, ast densioribus, fuscescentibus (the comparison is evidently with *G. pilosiuscula*). Frondes . . . lineari-lanceolatae, longitudine 3–5 poll. et ultra, vix plus 2 lin. latae, . . . supra glabrae, . . . praesertim ad marginem consitae, subtus pallidius virides, pilis sparsis, brevibus, nigro-fuscis, patulis."—Flora Javae.

Veins thrice forked are shown by the illustration.

The type is Herb. Lugd. Bat. sheet No. *908,300 . . . 187,* in fair condition. Its paleae are about 1.5 mm long, ovate, acute. The dense pubescence of the stipe is mostly 0.3 mm long, with an occasional longer hair, tawny-brown. The hairs of the margin are longer and very dark; they have mostly been lost. The sori are superficial, roundish when mature; there is a suggestion of a second series of sori,—as is likely to occur where the veins bear several veinlets. In spite of the lapse of time, plural short, dark setulae are present beside the annulus.

FIG. 81

On newer collections, I find the paleae 2 mm long. Young fronds are fairly abundantly setulose beneath with reddish-brown hairs, very sparsely so above.

JAVA: six old collections of which only *Zippelius 113* bears data for citation, *Palmer* and *Bryant 444* (mostly), *Ramaley 546.* SUMATRA: *Bartlett 7945* (very large and sori pluriseriate). BORNEO: *Brooks 14a, Clemens 29061, 30679, 31729, 32387, 32570, 50150* (type of *G. petrophila*). PHILIPPINES. Mindanao: *Copeland 1008'* (mostly), *1523.* Negros: *Elmer 9734A.* Luzon: *Williams 1581* (type of *G. brevipila*), *1582*

(type of *G. duplopilosa*), *Vanoverbergh 1025, Copeland s. n.* (from Mt. Banajao). ANNAM: *Pételot 3533.*

113. GRAMMITIS FENICIS Copel.

Grammitis Fenicis Copel., Univ. Calif. Publ. Bot. 18 (1942) 224.

Rhizomate breve, adscendente, paleis brunneis 1.5–2 mm longis lanceolatis acutis vestito; stipitibus caespitosis, 1 cm longis, gracilibus, nigro-fuscis, setis fuscis plerisque 0.4–0.5 mm longis nonnullis paulo longioribus dense obsitis; lamina 6–10 cm longa, 5–7 mm lata, obtusa, basi brevi-attenuata, integra, fusco-olivacea, herbacea, utraque facie setosa, setis 0.4–0.8 mm longis densissime et 1 mm longis saepe fasciculatis sparsius ciliata; venis furcatis, venula basiscopica, ubi lamina lata, iterum furcata, marginem non attingente, acroscopica prope basin sorifera, aut sub soro terminante aut supra sorum plus minus prolongata; soris subcostalibus, plerisque leviter impressis, parvis, orbicularibus, sporangiis crescentibus setulis debilibus ferrugineis munitis, ante maturitatem glabratis.

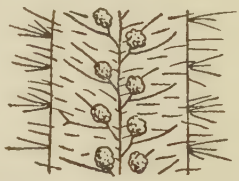

FIG. 82

PHILIPPINES: Batanes Islands, Mt. Iraya, *Bur. Sci. 80147 Ramos,* type in Philip. Nat. Herb., *ibidem, Fenix 3804;* Sto. Domingo de Basco, *Fenix 3802.* The three collections are very uniform. I have named the species for Eugenio Fenix, its first collector and the first American trained Filipino collector; but have made Ramos' collection the type, because it is the only one distributed to other herbaria.

G. Fenicis resembles *G. jagoriana* in its (less numerous) tufted setae; *G. congener* in other features of its (more dense) pubescence; and *G. dorsipila* in appearance.

Similar to *G. Fenicis* in pubescence, but larger, and with distinctly impressed sori, is a plant of Antique Province, Panay Island, *McGregor 5861* and *5863,* both without duplicates, in Philip. Nat. Herb. It is probably an undescribed species, but may as well remain so until more adequately collected.

114. GRAMMITIS MICROTRICHA Copel.

Grammitis microtricha Copel., Philip. Jour. Sci. 56 (1935) 105, *pl. 11.*

"Inter G. pleiosoram . . . et G. sumatranam . . ., pube stipitis 2 cm longi densa et brevissima, lamina subcoriacea minute pubescente sat dense et brevissime ciliata, ca. 12 cm longa, 10–12 mm lata, crenata, venis pluriramosis immersis, soris superficialibus, globosis, pluriseriatis vel irregulariter sparsis.

"Mindanao, Cotabato, Guinatilan (west base of Mt. Apo), altitude 1,000 meters, *Copeland s. n.,* September, 1933, on mossy trunk."—Copeland, l. c.

This is as isolated a species in Mindanao as *G. Havilandii* is in Borneo. The two look much alike, but the extremely minute pubescence of *G. microtricha* distinguishes it well. The illustration by Alicbusan (1. c., *pl. 11*) is excellent.

115. GRAMMITIS LIMAPES Copel.

Grammitis limapes Copel., Philip. Jour. Sci. **46** (1931) 218.
Polypodium limapes C. Chr., Suppl. **III** (1934) 152.

"Species G. pubinerviae et G. (Polypodio) bulbotrichae affinis robustior; rhizomate repente vel suberecto, 1½–2 mm crasso, paleis ferrugineis ovatis 1–2 mm longis vestito; stipitibus approximatis, basi articulatis, 5–7 cm altis, 1 mm crassis, pilis 1 mm longis atropurpureis debilibus vestitis et ob baseos bulbosos pilorum omnino horridis; fronde vulgo 15, rarius usque ad 30 cm alta, maxima 9 mm lata, utrinque sed ad basim imam abrupte angustata, integra, inferne praecipue ad costan deorsum setis minutis sparsissimis deciduis vestita aliter glabra, rigide coriacea, costa valida inferne prominente nigra; venis furcatis et, ubi satis lata frons, ramo basiscopico item furcato, ramo acroscopico breve; soris medialibus vel costae paullo propioribus, fere superficialibus, 2 mm latis, 2–3 mm longis haud confluentibus, sporangiis setis nigris brevibus obsitis.

"Java, Gedeh, Panggrango, *Copeland,* May, 1915, altitude 2,800 meters.

"This differs from Gedeh specimens identified as *G. pubinervia* in being decidedly stouter and more rigid, with larger sori, as well as in the peculiarity of the stipes, exceedingly rough to the eye and to the touch. *Grammitis pubinervia* and *G. congener,* as I construe them, have ordinary hairs on the stipe, stiffer than those of *G. limapes* but without enlarged bases. The Philippine *G. bulbotricha, Polypodium bulbotrichum* Copel., Philip. Jour. Sci. **40** (1929) 309, is likewise less robust and with smaller, as well as more costal, sori."—Copeland, l. c.

In Herb. Lugd. Bat. from Panggrango and Sumbawa, and from Sumatra, *Bünnemeyer 9777.*

FIG. 83

116. GRAMMITIS BULBOTRICHA Copel.

Grammitis bulbotricha Copel., Philip. Jour. Sci. **46** (1931) 219.
Polypodium bulbotrichum Copel., Philip. Jour. Sci. **40** (1929) 309.

"Grammitis, rhizomate brevi-repente vel suberecto, paleis ferrugineis ovatis obtusis vel apiculatis 1.5–2 mm longis vestito; stipitibus subfasciculatis, non vel vestigialiter articulatis, usque ad 6 (plerisque 3–4) cm longis, gracilibus, pilis castaneis debilibus et fragilibus usque ad 2 mm longis basibus plerumque inflatis interdum praestantim mammiformibus

obsitis, deinde, pilis abrasis, plus minus horridulis; fronde lineare, usque ad 16 (plerumque ca. 10) cm longa, utrinque angustata, in herbario fusca et subcoriacea, sparse castaneo-setosa, nisi prope soros glabrescente, decidue ciliata, in parte superiore cum pilis aliquot secus marginem sursumflexis, costa nigrescente; venis inconspicuis, saepe bis furcatis; soris subcostalibus, ad venulas infimas acroscopicas, setis protectis, receptaculo paullo elongato.

"LUZON, Mountain Province, Mount Pulog, altitude 2,650 meters, *Copeland P. P. E. 136* (type), epiphytic in mossy forest, May 12, 1909, *Merrill 6376, For. Bur. 16297 Curran, Merrill* and *Zschokke;* Pauai, altitude 2,100 meters, *Copeland 1949,* November, 1905, *Bur. Sci. 31960 Santos, Topping 1117;* Mt. Bulusan, altitude 2,650 meters *Copeland s. n.,* May, 1913.

"This species has been distributed as *P. congenerum* and *P. caespitosum,* from both of which it is distinguished by the long hairs on the stipe, their stipes being densely shortpubescent . . ."—Copeland, l. c.

The veins are commonly twice forked, rarely thrice forked. In correlation with the latter condition, one frond of the type has irregularly scattered sori outside the regular row. Some young sporangia bear light, caducous setulae; but, by the time the sporangia approach maturity, protection against water is afforded by the long, dark setae surrounding the sori.

FIG. 84

Near *G. scabristipes* of New Guinea, which has a rougher stipe, fewer hairs on the frond, more elongate sori, and freely setulose sporangia.

117. GRAMMITIS MERRILLII Copel., comb. nov.

Polypodium Merrillii Copel., Perkins' Fragmenta (1905) 188.

"Rhizomate brevi, erecto, paleis parvis brunneis vestito; fronde minuta, sessili vel in stipitem brevem attenuata, lineari-oblanceolata, obtusa, integra, coriacea, pilis sparsis brevibus, cinnamomeis, praecipue ad paginam superiorem marginemque vestita; costa conspicua, venis simplicibus immersis; soris superficialibus, costalibus, orbicularibus, magnís, quam media lamina latioribus, igitur in seriem unam sinuosam instructis, ad frondem unam quamque ca. 6.

"Paragua Isl., on stones by a brook (*Merrill no. 754*).

"This is the smallest *Polypodium.* The largest fronds are 23 mm long and less than 2 mm broad. The caudices are less than 5 mm high, and, including the leaf-bases, 1.5 mm thick.—Copeland, l. c.

The type of this species, which was in the herbarium of the Bureau of Science, later the Philippine National Herbarium, has presumably been destroyed. It must have been a single specimen, as a complete set of duplicates was sent to the U. S. National Herbarium, and this is not there. The sole subsequent collection is *Robinson 1969,* from Amboyna. This fits

the description except that the veins are prominent; they all look simple, but the sorus really occupies an obsolescent branch. The Robinson specimen is even smaller than the original, but is sparingly fertile. I do not recognize this as a dwarf of any known species. The apparent distribution, Palawan and Amboyna, is remarkable, but so minute a fern may have eluded collectors in many places.

118. GRAMMITIS JAGORIANA (Mett.) Copel.

Grammitis jagoriana (Mett.) Copel., Philip. Jour. Sci. **56** (1935) 478.
Polypodium jagorianum Mett., Linnaea **36** (1869) 128.
P. Koordersii Christ, Ann. Buit. **15** (1898) 144, *pl. 15.*
P. Christii Copel., Polyp. Philip. (1905) 118.
Grammitis cuneifolia Copel., Philip. Jour. Sci. **56** (1935) 479, *pl. 8, fig. 2.*

"Rhizoma caespitosum abbreviatum s. elongatum paleis pallide rubellis 1–1½ longis, ovato-lanceolatis squamosum; folia multifaria, coriacea, undique setosa, setis difformibus marginis fasciculatis, vix ½‴ longis rigidis, rufescentibus, paginae indivisis solitariis paulo longioribus denique cinnamomeis; petiolus ⅛–⅔″ longus, dense rufo-setosus; lamina 1–3″ logan, 2–3‴ lata, linearis, basi longe ac sensim in petiolum attenuata, apice attenuato obtusa; nervi immersi, furcati s. inferiores trifurcati, apice non s. vix incrassati; sorus in dorso s. apice rami antici plerumque abbreviati, costae approximati, elliptico rotundati, contigui; sporangia partim seta 1 longissima praedita; setae paucae sporangiis admixtae.

"Ins. Philippinae, Luzon (*Fedor, Jagor. 835,* ao. 1861).

"Habitu *P. hirtelli,* setis marginis fasciculis ternatis-quinatis aliisque notis insigne."—Mettenius, l. c.

The careful Mettenius merited that praise (Hooker's) for this description. Rhizome erect, paleae rust-brown, 2 (rarely 3) mm long, acute; stipes commonly 5 to 10 mm long, sometimes obsolete, densely short-hairy; lamina commonly 5 cm long, rarely up to 10 cm, 2.5 to 5 to 9 mm broad, typically coriaceous and dark, but sometimes thinner and translucent, hairs of the surfaces almost all solitary and rather sparse, marginal hairs solitary, binate or clustered in tufts of even up to eight, reddish-fuscous becoming black; receptacles elongate and oblique on the broader fronds, sori practically round, superficial, old fronds often becoming concave (as seen from beneath) between the veins. Plural setulae are sometimes present on young sporangia, but the solitary setae on a few sporangia, considerably exceeding the diameter of the latter, are present on the type collections of *P. jagorianum, P. Koordersii* and *P. Christii,* and I now find a very few on that of *G. cuneifolia.*

FIG. 85

As to the species reduced, having the four type collections in hand for comparison, I am in no doubt. The three reduced were described from narrow forms, but a fertile frond of the type fragment of *P. jagorianum* is only 3 mm wide. Judging by the isotype of *P. Koordersii* in Herb. Lugd. Bat., Christ's enlarged figure over-emphasized the unevenness of the margin. The type of *P. Christii* is notable for the paucity of clustered hairs, but they are present. The absence of twice-forked veins in the reduced species is due to the narrowness of the fronds.

LUZON: *Jagor,* the type collection; Mt. Mariveles, *Merrill 3230, Copeland 1974, Williams 669;* Mt. Maquiling, *Copeland 2022, P. P. E. 270, Merrill 7239, Elmer 14691;* Mt. Banajao, *Steere* (as *P. hirtellum*), *Elmer 7938;* Tayabas, *Bur. Sci. 9372 Robinson;* MINDORO: *Merrill 5966;* PANAY: *For. Bur. 16911, McGregor 5860;* NEGROS: *Whitford 1554, Elmer 10085;* CAMIGUIN: *Bur. Sci. 14824, 14831 partim Ramos;* MINDANAO: Mt. Apo, Copeland *1101* (type of *P. Christii*), *1520;* JOLO: *Clemens 9347;* CELEBES: Minahasa, *Koorders 17135* (type collection of *P. Koordersii;* BORNEO: Mt. Kinabalu, *Clemens 40016, 40962* (type of *G. cuneifolia*). Always in very mossy woods at moderate altitudes.

119. GRAMMITIS HIRTELLA (Blume) Copel.

Grammitis hirtella (Blume) Copel., Univ. Calif. Publ. Bot. **18** (1942) 224.

Polypodium hirtellum Blume, Enum. (1828) 122.

Grammitis pusilla Blume, Flora Javae II (1829) 109, *pl. 46, fig. 4,* excl. vars.

"P. frondibus brevi stipitatis linearibus obtusiusculis basi attenuatis integerrimis membranaceis, subaveniis utrinque hirtis, soris solitarüs, caudice caespitoso paleaceo.

"Crescit in sylvis elatis supra arbores."—Blume, Enum.

"Paleae pro portione majusculae, imbricatae, oblongo-lanceolatae, obtusiusculae vel acuminatae, integerrimae vel obsolete denticulatae, rarius lacerae, scariosae, pallide ferrugineae, vetustiores saturatiores, pulchre reticulatae.

"Stipites brevissimi 2–3 lin. longi crassitie setae porcinae, nigro-fusci, setis longis, ferrugineis, patentibus reflexisve hirsuti.

"Frondes fasciculatae, . . . 1½–2¾-pollicares, circiter 2 lin. latae, lineares vel spatulato-lineares, obtusiusculae, basi angustatae, integerrimae vel levissime repandae, membranaceae, planae, exsiccae regulosae, ... venulis obsoletis furcatis, utrinque, margine praesertim, setis similibus atque caudex hirsutae.

"Sori rub evolutione quâ puncta fusca in medio marginem inter costamque ramulo superiori venulae furcatae medio aliquantulum dilatatae inserti. . . . setis aliquot longis ferrugineis obsessis; evoluti magni con-

vexi, fusci, demum ita confluentes, ut costa media prope obtegatur."—Flora Javae.

I have from Leiden no specimens of this species (those received under this name being *G. adspersa*), nor of the plants referred to it by Blume in Flora Javae as varieties *alpestris* and *lasiosora*. A badly broken specimen in Herb. N. Y. Bot. Garden, ex Herb. Lugd. Bat. in 1866, may be original. Of the species and of var. *alpestris*, I have Java specimens which conform so perfectly to Blume's descriptions and figures that I feel certain of the identification. They seem to me, as they did originally to Blume, to be distinct enough to be treated more conveniently as two species; the variety is then *G. ludens*.

FIG. 86

The venation is a critically important characteristic, and is not illustrated by Blume. He distinguishes *G. pilosiuscula* from this species by the veins, "in illa enim trifidae, in hac bifidae." And his expression already quoted, "venulae medio aliquantulum dilatatae," is most significant; the medial sori are medial also on the veinlets. The fertile veinlets are elongate, more or less as long as the sterile ones. This is true of *G. hirtella* and *G. ludens*, but not of any other species with which they might be confused.

The paleae are small, about 1 mm long; hairs of stipe and lamina rather abundant, mostly about the same length, sometimes up to 1.7 mm; setae on the sporangia abundant, fairly persistent, exceeding the diameter of the sporangia. Setae as well as paleae darken with age.

JAVA: Gedeh, *Copeland s. n., O. Kunze 4741* in Herb. N. Y. Bot. Garden, *Clemens 30532;* Idjen, *v. Goebel* in Herb. Univ. Calif. MALAY PENINSULA: Cameron Highlands, alt. 4,800 feet, *Holttum 23348;* also several unnumbered collections. *Holttum 23309*, Cameron Highlands, is about as near to *G. ludens* as to *G. hirtella*.

The group of *G. hirtella* is remarkably diversified in the mountains of the Peninsula, and represented by many collections in the Singapore herbarium. I have tried first to construe it as one ill-definable species. But, with more study, have decided that, besides *G. hirtella* and what is approximately *G. ludens*, *G. Holttumii* and *G. peninsularis*, which follow, are well defined; and that there are still two species which will probably be recognized and named when better known.

119a. GRAMMITIS NANA Fée

Grammitis nana Fée, 6th. Mémoire (1853) 7, *pl. 6, fig. 1.*

"Frondibus parvulis, obtusis, hirtis, opacis, in petiolum desinentibus, pilis rigidis, acutis, nigris coopertis; nervillis simplicibus, scalpturatis; mesoneuro valido; rhizomate dendroideo; sporotheciis approximatis, confluentibus, apicilaribus, cum pilis laminarum immixtis; sporangiis subrotundis, pedicello tenui; annulo lato, articulis 11–12 crassis remotisque; sporis rotundis, nigrescentibus.

"Habitat in Java (Lobb?)

"Grammitis pusilla, Blum., Fil. Javae, p. 109, var. lasiosora, γ tab. 46, fig. 6.

"Icon. Tab. VI, fig. 1.

"Le *Grammitis nana* est l'une des plus petites fougères connues; mais il se pourrait que le spécimen adulte que nous possédons fut plut petit que les autres. Les frondes sont remarquables par la grande quantité de poils squamiformes, roides et noirâtres qui les recouvrente, et que l'on trouve toujours mêlés aux sporanges; celles-ci sont arrondies, assez grosses, un peu enfoncées dans la lame et confluentes, de manière à rappeler in disposition des *acrostichées.* Nous n'avons pas vu, sur le sacculus, les poils qui le retrouvent dans la plupart des autres, espèces. Notre spécimen est chargé, sur divers points des lames, d'une *usnea* stérile qui paraît étre *l'U filaris* ou *trichoidea* Ach; ce qui prouve que cette petite plante a une très-longue existence. *G. pusilla,* dont M. Blume a représenté trois formes dans son bel ouvrage sur les fougères de Java, est differente. Les expressions *caudex brevissimus, crassitie fili ferrei mediocris . . . frondibus membranaceis, sub aveniis* ne conviennent pas. D'ailleurs nous croyons que parmi les variétés etablies par le savant botaniste, il en est une qui mérite d'être élevée á la condition d'espece. C'est la var. γ *lasiosora* du *G. pusilla,* qui suele peut être rapprochée de notre espèce."—Fée, l. c.

It is to be noted that the citation of Lobb as collector, and of *G. pusilla* var. *lasiosora* as a synonym are uncertain. Hooker, Sp. Fil. IV 166, presently raised the letter to specific rank, citing only Blume as a collector, but citing *G. nana* as a synonym. Hooker's description agrees about equally well, and equally ill, with Blume's and Fée's. If the plants are the same, Fée's name, *nana,* has priority as that of a species.

The clearest fact as to the type of *G. nana* is that it was an old individual; to this, the dendroid caudex testifies even more strongly than the presence of lichens. When the rhizome of any tufted *Grammitis* reaches this condition, the fronds must be expected to be dwindling, on the way to death. The specimen was probably dwarfed by exposure also, as is indicated by the lichens. Exposed specimens naturally have thicker and more opaque fronds than characterize the species where normally sheltered. As more than one hairy species, dwarfed by

age and exposure, might conform to Fée's description, the application of his name remains uncertain.

POLYPODIUM LASIOSORUM (Blume) Hooker

Polypodium lasiosorum (Blume) Hooker, Sp. Fil. IV (1862) 166.
Grammitis pusilla var. *lasiosora* Blume, Flora Javae II (1929) 110.

"γ Lasiosora; frondibus coriaceis subintegerrimis utrinque stipiteque hirtis; soris confluentibus villosis.

"Habitat: Ad arborum truncos veternos muscosos, in jugis superioribus montis *Pangerangu*. Facie omnino praecedentis (β Alpestris), distinguitus notis modo indicatis, soris longe majoribus lana ferruginéâ dense óbtectis frondibusque magis congestis, ita ut caudicis, paleae vix distinguantur, quae omnia ex imagine nostrâ linquent."—Blume, l. c.

I see no reason to question Hooker's identification of *G. nana* Fée and *P. lasiosorum*. But, if they are identical, *Grammitis nana* is the tenable name, and *P. lasiosorum* is a synonym. I recognize no Java specimen as referable to this species, and so can interpret it only by the publications. Fée says the veins are simple, which is most unlikely; Hooker says they are not discernible, which is not helpful; and Blume did not mention them. Christensen, Gardens' Bull. 7:294; Suppl. III 151, has recently revived *P. lasiosorum* Hooker. He evidently knew it as a plant of Java (l. c., p. 294), although doubtful of the identity of his Borneo specimen, *Holttum 26872*. He says most truly: "It is almost impossible to name with certainty the many Malayan species of this group without direct comparison with type-specimens." The Borneo specimen has short fertile veinlets, suggesting *G. Reinwardtii*. If this is true of the Java plant, it is distinct indeed from *G. hirtella*. I have also Christensen's identification as *P. lasiosorum* on a Chinese plant, which I suppose, as he does, to be *P. dorsipilum* Christ, and which I so treat.

120. GRAMMITIS LUDENS (Baker) Copel., comb. nov. **Plate 6.**

Polypodium ludens Baker, Annals Bot. 8 (1894) 129.
P. alpestre Blume, Enum. (1828)123, *non* Spann. (1825).
Grammitis pusilla var. *alpestris* Blume, Flora Javae (1829) 110, *pl. 46, fig. 5*.
P. hirtellum var., C. Chr., Index 533, and of many authors.
P. sparsipilum Copel., Philip. Jour. Sci. 6C (1911) 139.
Grammitis multifolia Copel., Philip. Jour. Sci. 46 (1931) 219.
Polypodium multifolium C. Chr., Suppl. III (1934) 154.

"Rhizomate breviter repente, paleis basalibus densis late lanceolatis pallide brunneis, stipitibus productis paleis subulatis brunneis recurvatis praeditis, frondibus lanceolatis subcoriaceis utrinque nudis integris vel prope medium irregulariter lobatis ad basin angustatis, venis furcatis

erecto-patentibus immersis obscuris, soris oblongis superficialibus obliquis utrinque prope costam uniseriatis.

"Hab. Java, *Hancock* 53 a!

"Stipites 2–3 poll. longi. Lamina 6–8 poll longa, medio (lobis exclusis) 4–6 lin. lata.

"Near *P. fasciatum* Mett."—Baker, l. c.

The name, *ludens,* was evidently applied in appreciation of the occasional outgrowths of the frond, "irregulariter lobatis," but is especially appropriate to the type collection because it is so ample a mixture. The isotype in U. S. Nat. Herb. consists, besides a pocket of fragments, of three clumps of *P. alpestre* Blume, two plants of *G. Reinwardtii,* one of *G. fasciculata* and one of *G. obscura.* The first can be chosen positively as *P. ludens,* because it is the only one with the outgrowths responsible for the name. Christensen, Suppl. III 152, elected the *P. obscurum* element as the subject of description; it is the one with somewhat retrorse hairs, and has fronds of the stated size; but it is quite entire (in the material I have seen), and is rigidly coriaceous.

FIG. 87

G. ludens is indeed very close to *G. hirtella.* It is distinguished by longer stipes, repand or more irregular margin, and usually thinner fronds. Blume knew these differences, and may have judged well that the two are only varietally distinct. It is a matter of judgment, and I prefer not to make varietal distinctions.

In describing *G. multifolia,* I recognized the probability that it was *P. alpestre* Blume, but described it anew because not quite sure; I feel no guilt for failing to identify it as *P. ludens.* Failure to take account of my own *P. sparsipilum* was less excusable.

Rhizome short; paleae about 1 mm long, brown, acute, very inconspicuous; stipes densely clustered, commonly 2 to 4 cm long, slender, setae sparse on the single stipe, but forming a mass because the stipes are numerous, mostly 1 to 1.5 mm (sometimes over 2 mm) long, tawny; veins once forked, the branches subequal, or the basiscopic veinlet often again forked in correlation with unevenness of margin; sori basal on their veinlets, receptacles elongate, sori slightly so, young sporangia freely setose with light-brown deciduous bristles.

I have seen no Blume specimen, and therefore construe *P. alpestre* by description; Blume's statement that the fronds are naked could be due to age.

JAVA: *Hancock 53a partim, Wichura 98, Möller* (1907, ex-herb. C. Chr.), *Palmer* and *Bryant 885, Copeland* (1915, type of *G. multifolia*), *Clemens 3032,* Raciborski collected it several times; one of his specimens in Philip. Nat. Herb. was laciniate, like the type. BORNEO: *Brooks 14* (type of *P. sparsipilum*), *Clemens 32759.* Peninsular collections conforming approximately to those of Java, but thicker in texture, are *Haniff 4059* and *Scortechini* without data.

Wray 1553 has broader fronds and slightly impressed sori. This and the Haniff and Scortechini specimens might be *G. ludens;* but I think they are more probably inperfectly developed specimens of the Gunung Tahan plant, *Ridley 15976,* and *Wray* and *Robinson 5478,* which resembles both *G. setosa* and *G. ludens.* Its stipe is 3 cm long, its hairs, 1.5 mm; fronds up to 20 cm long and 8 mm broad, subcoriaceous, sparsely ciliate and with some hairs on the costa, but almost glabrescent; veins forked, the basiscopic veinlet often forked again, fertile veinlet prolonged but not approaching the margin; sori subcostal, distinctly but not deeply impressed. It is probably a distinct local species.

121. GRAMMITIS HOLTTUMII Copel.

Grammitis Holttumii Copel., Univ. Calif. Publ. Bot. **18** (1942) 224.

G. hirtellae affinis, fronde ubique setis usque ad 3 mm longis dense obsita distincta; paleis inter stipites setosos fasciculatos occultis; frondibus 6–10 cm longis, linearioblanceolatis; venis furcatis, venulis ambabus fere ad marginem prolongatis; soris inframedialibus, orbicularibus, sporangiis setis quam diametro capsularum paulo longioribus munitis.

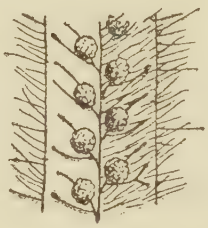

FIG. 88

MALAY PENINSULA: Cameron Highlands, alt. 4,800 feet. *Holttum 23384,* April 3, 1930. On mossy tree trunks.

A member of the locally diversified group of *G. hirtella.* It might possibly be regarded as *Polypodium lasiosorum* Hooker. As already observed, the identity of this must finally be fixed by Blume's specimen, which I have not seen. As well as I can decide what Blume's plant is, *G. Holttumii* is a larger plant, with relatively short stipe, and much longer hair.

122. GRAMMITIS PENINSULARIS Copel.

Grammitis peninsularis Copel., Univ. Calif. Publ. Bot. **18** (1942) 224.

G. rhizomatis brevis apice paleis ferrugineis lanceolatis et ovatis 1.5 mm longis immerso; stipitibus fasciculatis, 0–5 mm

longis, setuliferis; fronde 3–5 (rarius 6) cm longa, 3–4 mm lata, anguste oblanceolata, obtusa, deorsum sensim decrescente, subcoriacea, setulis ca. 0.4 mm longis nigrescentibus ubique, margine densissime, obsita; venis gracilibus inconspicuis furcatis, venula fertile protensa nec sterili aequale; soris inframedialibus, orbicularibus. superficialibus, supra basin venulae impositis, receptaculo brevioblongo, sporangiis parvis setosis.

FIG. 89

MALAY PENINSULA: Gunung Tahan, alt. 5,000 feet, *Holttum 20678,* type, "On mossy trunks by streams." Also, Mt. Ophir, alt. 3,500 feet, *Holttum 23701;* Gunung Belumut, 3,000 feet, *Holttum 10680 bis;* Gunung Mering, *Ridley* (*Nair Dzan 3354.*

A relative of *G. hirtella,* well distinguished by the abundant but very short pubescence.

There are two specimens, *Burkill 12705* from Maxwell's Hill, alt. 3,300 feet, and *Ridley s. n.* from the Taiping Hills, which are like *G. peninsularis* in pubescence, but like *G. reinwardtioides* in form and venation. They probably represent a distinct species.

122a. GRAMMITIS CRISPATULA Holttum

Grammitis crispatula Holttum, Gardens' Bull. 11 (1947) 268.

"Paleae rhizomatis angustae, acutae, 2 mm. longae, pallide brunneae, integrae. Stipites c. 1 cm. longi, pilis rufis confertis patentibus ½ mm. longis vestiti. Frondes tenues, 4–10 cm. longae, 6–8 mm. latae, basi abrupte angustatae, apicem versus sensim angustatae, apice obtusae, marginibus omnino crispatulis utroque latere pilis brevissimis patentibus vestitae. Venae unifurcatae, rami inaequales, rzmus acroscopicus brevior, cum costa parallelus, ramus basiscopicus longior, patens, marginem non attingens; sori ramos acroscopicos venarum occupantes, prope costam, non contiqui.

Typus: Perak, Maxwell's Hill, 3300 ped. alt., S. F. N. *12705,* leg. *Burkill,* 6 March, 1924.

This species is characterized by its short hairs and simple basal veinbranch."

122a. GRAMMITIS CRISPATULA Holttum

Polypodium bongoense Copel., Philip. Jour. Sci. **38** (1929) 153.

P. Brooksii Copel., Philip. Jour. Sci. **12C** (1917) 60, *non* C. Chr., Suppl. I (1913) 4, 58.

P. hirtellum Brooks in Sarawak Museum Jour. **1** (1912) 49, *non* Blume.

"Grammitis, rhizomate suberecto, paleis pallide brunneis ovatis obtusis vel acutis vestito; stipitibus confertis, haud articulatis, filiformibus, 0.5 ad 1 cm longis, pilis vinicoloribus 1 ad 2 mm longis ornatis; fronde 4 ad 7 cm alta, plerumque ca. 3 mm, rarius usque ad 5 mm lata, obtusa vel subacuta, deorsum sensim angustata, integra subcoriacea, ubique

setosa, setis usque ad 3 mm longis, rubidis; venis sterilibus plerisque simplicibus, fertilibus prope costam furcatis, soro orbiculare ramum superiorem brevissimum insidente et complente, receptaculo subelongato.

"Sarawak, Mount Bongo, *Brooks*, February, 1908.

"My specimens of *Polypodium Brooksii* are somewhat old and the sporangia seem to be naked; those of *P. Reinwardtii* and *P. hirtellum* bear a few setae."—Copeland, 1917.

Clemens 20448, from Mt. Poi, Sarawak, is younger material than the type, and bears a few castaneous setulae on the sporangium. Paleae a scant millimeter long, lanceolate-ovate or ovate.

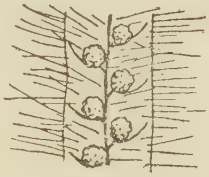

FIG. 90

124. GRAMMITIS REINWARDTIOIDES Copel.

Grammitis reinwardtioides Copel., Philip. Jour. Sci. **56** (1935) 478, *pl. 10.*

"Rhizomate breve, paleis brunneis nitidis lanceolatis 1.5 mm longis apicibus protractis deciduis vestito; stipitibus gracillimís fasciculatis, ca. 1 cm longis, pilis pallidis usque ad 1.7 mm longis vestitis; fronde 10 ad 15 cm longa, 6 ad 9 mm lata, utrinque angustata, fusca, subcoriacea, costa et margine pilis longis ferrugineis obsitis, lamina fere glabra; venis late patentibus, furcatis, ramo acroscopico sorifero breve, altero haud ad marginem protracto; soris fere costalibus parvis, globosis (nec receptaculo elongato) superficialibus, sporangiis setiferis.

"Borneo, Mt. Kinabalu, Penibukan, "epiphyte by Dahobang River, altitude 3,500 to 4,500 feet," *Clemens 40792.*

"Differs from *G. Reinwardtii* in being more slender, less rigid, with longer hairs, and rather smaller sori. The veins are less conspicuous and less nearly horizóntal, the acroscopic branch less extremely short. Whether or not this is the fern mentioned by Christensen, Gardens' Bull. **7** (1934) 295, as similar to *G. Reinwardtii,* I do not try to guess. It is more like the plant I distributed as *G. jagoriana* than like that correctly so called . . ."—Copeland, l. c.

Endemic in Borneo. Besides the type, I have now, from Singapore, *Holttum 25399, 25737, 25738, 25743, Clemens 32463;* two collections, *Clemens s. n.,* one of which is dwarfed. *Clemens 27998* in U. S. Nat. Herb.,—all from Kinabalu, alt. ± 1,500 m; *Endert 4304* from W. Koetai, in Herb. Lugd. Bat.

It will be observed that I include here specimens treated by Christensen and Holttum as *P. Reinwardtii,* as doubtfully that species, and as *P. bongoense. G. reinwardtioides* is indeed an ill defined species. It differs from *G. Reinwardtii* in having inconspicuous venation, and usually more slender fronds and shorter stipes; from *G. bongoensis,* in being larger, but with shorter hairs. It is still more like *G. dorsipila* but is distinctly

larger, and there are less tangible differences which satisfy me that they may not be combined.

I find some setulae on the sporangia of all specimens except *Holttum 25738,* but they are usually few and caducous. The young receptacle is somewhat elongate.

125. GRAMMITIS DORSIPILA (Christ) Copel.

Grammitis dorsipila (Christ) Copel., Univ. Calif. Publ. Bot. 18 (1942) 224.

Polypodium dorsipilum Christ, Monsunia I (1900) 59.

"Parvulum, e grege Eupolypodiorum linguaeformium. Caudice brevi, coespitoso, nudo. Frondibus pluribus breve stipitatis lingulato-linearibus apice obtusiusculis 5 cm longis, 2 mm latis, coriaceis, margine involutis rarius planis pilosis, pilis praecipue in margine et in dorso frondis secus lineam medialem positis, rigidis brevibus fragilibus. Costa infra prominente, supra linea notata, nervis simplicibus inconspicuis, soris uniseriatis nervis impositis, minutis, haud immersis.

"P. parasitico Mett. simile, sed frons angustior, pilique longi et flexiles. s. n. Süd-China.

"Forsan Grammitis pilosiuscula Blume Fl. Javae Tab. XLVI 2, sed ob iconem insufficientem non certe eruendum."—Christ, l. c.

This is an unusually bad description. I am very suspicious of any species described with naked rhizome, or with simple veins, in the Malay-Asiatic region. As to the speculation that it might be *G. pilosiuscula* Blume, the paleae of that species were described by its author.

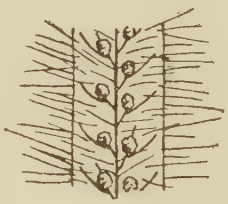

FIG. 91

I have from South China *Matthew 15, Merrill 10170* and *11109, Levine 514, Canton Christian College 9377* and *12399, Tsang 20342* and *24913,* all from Quangtung; *Chung 6711* from Fokien; *Tsang 24794* from Quangsi; *Eryl Smith 1548, Chun* and *Tso 44209,* from Hainan;—twelve collections of one species, which I think must be Christ's, as I have no other Chinese species unless it be *Canton Christian College 6872,* depauperate and badly preserved, but probably the same. I have tried to have this species checked with the type of *P. dorsipilum,* but Mme. Tardieu-Blot informs me, that this is not in Christ's herbarium; it may be in Berlin. It is not *G. hirtella,* though sometimes so named, by myself and others. I do not believe that it can be *P. lasiosorum,* which should be conspicuously long-stipitate; Christensen, Bull. Dept. Biol. Sun Yatsen Univ. No. 6 (1933) 14, is also in doubt, though he, Ching and Tutcher sometimes so named it. I will redescribe it, using

good Quangtung collections, *Merrill 11109* and *Canton Christian College 12399* as particular subjects.

Rhizome short, paleae 1 to 1.5 mm long, ovate, ferruginous; stipes densely clustered, up to 1 cm (commonly 6 mm) long, 0.4 mm thick, castaneous, densely clothed with bristles of variable length up to 1 mm long or a little longer; lamina 3 to 5 cm long, 4 to 6 mm wide, entire, apex rounded, base attenuate, thin-coriaceous, margin and surfaces beset with tawny hairs becoming fuscous when old, up to 2 mm long or even longer; veins forked above the base, the basiscopic branch approaching the margin, the acroscopic occupied by the sorus or less commonly prolonged but not nearly to the margin; receptacle short-oblong, sorus round, superficial, costal or subcostal, sporangia sparsely setulose but protected by the long laminar hairs.

Hainan specimens have longer paleae (up to 2 mm) and fronds (up to 9 cm), and shorter hairs on the stipe. The Fokien specimen is small.

Related to *G. Reinwardtii,* distinguished by inconspicuous veins, smaller and narrower lamina, firmer texture, and less conspicuously costal sori; The Hainan specimens are nearer to that species. Distinguished from *G. hirtella* by venation, and by dense hairiness.

A plant of the Bonin Islands, *Toyama s. n.,* sent me by Professor Tagawa as *G. hirtella,* may be referred to *G. dorsipila,* which it resembles in venation. It is larger (one frond 11 cm long), and less hairy than the Quangtung specimens. In the other direction, *Pételot 532,* in Philip. Nat. Herb., from Cao Ouac, alt. 1,900 m, comes from Northern Indo-China.

126. GRAMMITIS ASAHINAE (Ogata) Ito

Grammitis Asahinae (Ogata) Ito, Jour. Jap. Bot. 11 (1935) 91.
Polypodium Asahinae Ogata, Icones Fil. Jap. V (1933) *pl. 243.*

"Rhizoma brevissimum, e basi radiculosum. Radiculae tenerrimae, fuscescentes, lineares aut lanceolato-lineares, 2–8 cm. longae, 2–4 mm. latae, obtusiusculae, basi attenuatae, utrinque, margine praesertim hirsutae. Paleae oblongo-lanceolatae, acuminatae, integrae, pallide ferrugineae, circa basim frondis enatus. Venulae bifurcatae, ad basem versus simplices. Sori ramulo superiori venulae furcatae inserti, solitariae. Sporangia subglobosae, per ⅔ ambitus annulo ferrugineo cinctae, non setosae, pedicellis tenuissimis. Sporae ellipsoideae, opacae.

"Nom. Jap. Hime-urabosi.

"Hab. Kiusiu: Prov. Satsuma, Mt. Kaimondake; Ryukyu, kunigami Mt. yonahadake (leg. M. Ogata, 12. VIII. 1932)."—Ogata, l. c.

As the illustration shows, it is the fronds which are linear or linear-lanceolate, 2 to 8 cm long, etc.

The obvious accidents in this publication make a new description desirable: Rhizome short, erect, paleae 1.5 mm long, lanceolate, acute or acuminate, bright-brown; stipes clustered, 0 to 5 mm long, sparsely beset with castaneous hairs about 0.5 mm long; lamina of specimen seen 4 cm long, 2 mm wide, rounded at apex, attenuate to base, subcoriaceous, sparsely hairy on both surfaces with hairs 0.5 to 0.6 mm long; costa evident, veins immersed, once-forked, the fertile veinlet ending in the sorus or extended beyond it, sori infra-medial, superficial, small, receptacle oblong, sorus round; a few setulae detected on young sporangia, none persistent.

FIG. 92

By the courtesy of Professor Ito, I have a plant of Ogata's collection, cited above.

A relative of *G. dorsipila*,—in fact, in some respects, fitting Christ's description better than does the South-Chinese plant which I take for that species.

127. **POLYPODIUM KJELLBERGII C. Chr.**

Polypodium Kjellbergii C. Chr., Bot. Jahrb. **66** (1933) 63.

"*Grammitis* rhizomate brevi, paleis brunneis lanceolatis integris apice dense obtecto, foliis dense caespitosis, 6–13 cm longis, 4–6 mm latis, linearibus, lanceolatis vel oblanceolatis, breviter acuminatis, versus basin longe decrescentibus—stipite nullo vel brevissimo-papyraceis, in sicco laete brunneis, marginibus saepius undulato-repandulis, pilis paucis brevibus pallidis sparse ciliatis; nervo mediano inferne pilis pallidis brevibus sparse hirto, paginis utrisque glabris. Venis occultis, plerisque furcatis, ramulis subaequilongis, in hydathodas nigrescentes in pagina superiore medio inter nervum medianum et marginem distinctissimas terminantibus, ramo acroscopico solum sorifero. Soris nervo mediano approximatis, vix contiguis, juvenilibus oblongis, superficialibus vel leviter impressis, sporangiis setis 2–5 pallidis, rigidis, saepius geminatis, armatis.

"Nr. 1102, B. Watoewila 1300 m (1), Regenwald, 24 März.

"Nahe verwandt mit *P. pleurogrammoides* Rosenstock von Neu-Guinea, mit dem es in den meisten Merkmalen übereinstimmt. Es ist verschieden durch die grösseren Dimensionen, die blassen fast immer einfachen Haare, die sehr deutlichen Hydathoden und die borstigen jungen Sporangien."—C. Chr., l. c.

I know nothing about this Celebes species, beyond the description just quoted.

128. **GRAMMITIS REINWARDTII Blume**

Grammitis Reinwardtii Blume, Enum. (1828) Addend.; Flora Javae 114, *pl. 48, fig. 1.*

Polypodium Reinwardtii Presl, Tent. (1836) 180.

P. lasiosorum Bedd., Ferns Brit. India *pl. 172, non* Hooker.

P. hirtellum Bedd., ibid. *pl. 212, non* Blume.

"G. frondibus stipitatis spatulato-lanceolatis obtusis repandis sub-membranaceis furcato-venosis planis utrinque stipiteque pilosis, soris ovalibus costae approximatis sub-parallelis, caudice paleaceo.

"Differt Grammitidi pusillae Nob. fronde longius stipitata, venisque a basi inde bifurcis, ramo superiore brevissimo, inferiore marginem attingente. Qua de causa sori in Gr. *pusilla* a frondis costa multo remoriores, hic autem eidem sub-contigui sunt.—A specie praecedente (*G. obscura*) prima fronte vix distincta, fronde tamen tenuiore, venarumque structura memorata recedit. Namque venae in Gr. *obscura* adeo abbreviatae sunt, ut ipse exterior ramus vix medium costam inter marginemque attingat.

"Filix uti videtur caespitosa et probabiliter 5 poll, non excedens.

"Frons stipite pollicari, filum commune crasso, atro-fusco, ecanaliculato, basi fasciculo palearum oblongo-lanceolatarum acutarum ochracearum stipato, pilis longis patentibus ferrugineis ex toto villoso, 2½-pollicaris, ⅓ poll. lata, spatulato-lanceolata, obtusissima, basi attenuata, repanda, plana, sub-membranacea, nitidiuscula, utrinque, maxime ad marginem costamque subtus plano-convexam, pilis longis atrofuscis vestita, parallelo-venulosa, venis subtus distinctioribus, marginem versus sub-clavatis, basi sursum breviorem exserentibus ramulum, in venis acrophoris maxime abbreviatum et cum frondis costa angulum ferme acutum efformantem.

"Sori ovales, solitarii in venarum furcaturam ramis brevioribus, costae approximati atque paralleli, non immersi, ab ititio badii, postea saturate ferruginei. Capsulae globosae, breviter stipitatae, setis 2–3 longissimis fulvis obsessae."—Blume, Flora Javae.

This is a remarkably complete description for its time, especially if it be noted that Blume had avowedly a single frond. By his statement to this effect, I can fix the type, Herb. Ludg. Bat. No. 908,286 . . . 138, apparently from Celebes; but his artist constructed two more fronds in his illustration.

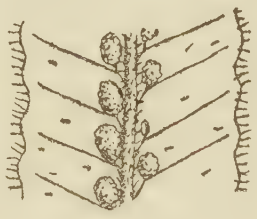

FIG. 93

The lonceolate paleae are 2 mm long; stipe 1 to 4 cm long; frond up to 15 cm long and 15 mm wide, entire or rarely crenulate; sporangia bearing dark, notably persistent setulae close to the annulus, often paired, one on each side of the annulus, about as long as the diameter of the sporangium.

JAVA: many collections from the Gedeh and Salak. CERAM: *Stresemann 39.* New Guinea (Ins. Rook) *Bamler R 31.* Admiralty Ids. *Grether* and *Wagner 4186.* MALAY PENINSULA: *Wray 896, 3889, Holttum 20654, 23808, 31406* (one plant with lateral outgrowths up to 14 mm long). PHILIPPINES: Benguet, *Copeland 1933, Bur. Sci. 5749 Ramos, 8388 McGregor, For. Bur. 16296, Merill 7780, Topping 1118;* Mt. Banajao, *Copeland 2134, Merrill 919, 7512, Bur. Sci. 19603 Ramos, For. Bur. 7973,*

8002; Tayabas, *Bur. Sci. 19390;* Negros, *Merrill 6962, 8031, Elmer 9734;* Mt. Apo, *Copeland 1008 partim, 1522, Williams 2487;* Mt. Matutum, *Copeland s. n.*

This is one of the more easily recognized species of the genus, marked by the conspicuous, wide-spreading veins and very short fertile veinlets. Most specimens conform very perfectly to the type. A few do not; I suspect these of being hybrid, and do not guess at the other parent.

As to Ceylon plants, the cited illustrations by Beddome, Ferns Brit. India, plates 172 and 212, seem clearly to represent *G. Reinwardtii,* and a specimen collected by Trimen in 1889, in Herb. Uni. Calif., belongs here.

128A. G. BEDDOMEANA (v.A.v.R.) Copel., comb. nov.

Polypodium beddomeanum v.A.v.R., Bull. Buit. **II** No. 28 (1918) 39.

The publication of this species reads as follows:

"We have in the Buitenzorg Herbarium a plant from Ceylon (G. Wall No. 30) received as P. hirtellum. It is the plant meant by Beddome as P. lasiosorum in Ferns Br. I. II, tab. CLXXII and as P. hirtellum l. c. tab. CCXII, but it is, however, neither the former nor the latter. The specimen in hand is very small, copiously ciliated and hairy, the fronds are to 3 cm long by 5 mm broad, on stalks to 5 mm long, the hairs are rufous, partly very long, partly very short, those of the upper surface rather few, of the under surface copious, those of the margin placed in tufts of 2 or more, the texture is firm but rather pellucid, the veins are invariably simple, bearing the sori at the base, but not on abbreviated veinules, the sporangia are apparently not setose but intermixed with hairs.—It is also not *P. Reinwardtii* Pr. and I propose to call it "Polypodium beddomeanum v.A.v.R.; P. lasiosorum Bedd. (not Hk.) Ferns Br. I., II tab. CLXXII; P. hirtellum Bedd. (not Bl.) l. c. tab. CCXII."

In spite of the statement that this is not *G. Reinwardtii,* I might have left it as a synonym of that species. But, as this monograph goes to press, I receive from W. A. Sledge, *No. 733,* collected December 17, 1950, a specimen which is clearly no *G. Reinwardtii,* but agrees in several respects with the description of *G. beddomeana.* It is like it in stature; the veins are inconspicuous as compared with *G. Reinwardtii,* and apparently simple. The sori are protected by remarkably long hairs. On the other hand, the marginal hairs are mostly simple, and the sori are medial. It may be *G. beddomeana,* or may represent still another species.

129. GRAMMITIS (SUBGENUS TRICHOTHEMELIUM) ATTENUATA Kunze

Grammitis (Subgenus *Trichothemelium*) *attenuata* Kunze, Linnaea **24** (1851) 251.

Polypodium parasiticum Mett., Polypodium (1857) 35; Beddome, Ferns S. India Handbook **55** Suppl. 85 (1892) 302, *pl. 165, non* L.

P. mediale Baker, Syn. Fil. (1874) 507.

"Character subgeneris Trichothemelii. Sporangia in receptaculo tenui, adpresso, oblongo, atro, carbonaceo, setis uncinatis cincto enata . . .

"Character speciei: Fronde crassa, coriacea, subtus sparsim nigro-setosa, ensiformi-lanceolata, obtusa, subapiculata, basi in stipitem brevem attenuata, margine revoluta, repanda subtus costata, alutacea, evenia; supra elevato-venosa; soris elliptico-oblongis subrotundisve, costae obliquis, mediis, elevatis, fuscis; stipite teretiusculo, dense uncinato-setuloso, basi et rhizomate brevi, repente, paleis minutis, bullatis, elevato-cellulosis obtectis.

"Ad corticem arborum in montibus Nilagir. rev. Schmid.

"Coll. univ. Jenens. coll. C. Koch.

"Rhizoma pennae corvinae tenuioris crassitie, al ¾‴ longum vidi. Frondes, exsiccatione fusco-virides, simul sumpto stipite 4–6 lineari plerumque 2″ longae, raro longiores, 2½–4‴ latae. Venae, erecto-patentes, furcatim divisae, ramo superiore, more generis, fertili, apicibus incrassatis. Receptaculum sori placentaeforme, tenue, atrum, carbonaceum, ab initio cinctum setis uncatis, demum inter sporangia persistentibus, illis frondis similibus.—Receptaculum perspicuum et sori setis atris uncatis interspersi speciem a reliquis *Grammitidis* speciebus, ceterum habitu affinibus, plantulam rostram distinguunt."—Kunze, l. c.

The Gray Herbarium contains one sheet, ex Herb. William Ferguson of Columbo, ultimate source unknown, which conforms to Kunze's description except in width of frond:—Rhizome creeping, nearly an inch long, paleae brown, 1 to 1½ mm long, broadly lanceolate; stipes velutinous; lamina 2 to 2½ mm wide; sori terminal on somewhat elongate veinlets, medial; sporangia bearing copious persistent, dark, curved setulae. The young receptacles are conspicuous and setulose; I am uncertain as to the source of these setulae,—whether or not on very young sporangia. It is in the nature of the case that protective trichomes mature before the structures they protect. *Perrotet 1490* in Herb. Lugd. Bat., from the Nilgiris, is old material but some sporangial setulae can be detected; the rhizome is creeping and the laminae 5 mm wide. In both herbaria are other collections, including *C. P. 1283,* with the sporangia naked or very nearly so. Beddome (1892) says he never saw creeping rhizomes on Nilgiri specimens; but the material in hand (eight collections) from both the Nilgiris and Ceylon shows both creeping and short, erect rhizomes from both sources. Either this is a variable species, in the rhizome, shape of frond, and setulae, or I am confusing more than one species.

Polypodium parasiticum is a clear synonym, another name for the same plant. If more than one species is here included, *P. mediale* might be the other, but there is nothing distinctive in its description. Baker placed it well away from his *P.*

parasiticum because he thought the sori were of different shape. Beddome shows both round and elongate sori on the same plant. I find the receptacles and very young sori elongate, but the mature sori round or nearly so.

130. GRAMMITIS ZEYLANICA Fée

Grammitis zeylanica Fée, Genera (1850–'52) 234.

Polypodium zeylanicum Mett., Polypodium (1857) 38; Hooker, Sp. Fil. IV. 169, *pl. 272B;* Beddome, Ferns S. India *pl. 237.*

"Frondibus lanceolatis, undulatis, acutis, membranaceis, fasciculatis; nervillis flabellatim bifurcatis, ramis subaequalibus, superiore prolífero; rachi filiformi, piloso; pilis horizontalibus, rufescentíbus; sporotheciis subrotundis; receptaculo ovoideo; sporangiis ellipticis, pedicello longo; annulo 12–13 articulato, sporis irregulariter ovoideis.

"Habitat in insula Zeylona. (Gardner, no. 56).

"Filix membranacea, margine undulata, aliquando lacerata.

"(Dimensions: longueur des frondes, 15–17 centim., sur 1 centim. de largeur; le stipe a environ 3 centim. de hauteur; les fronds ne sont fructifiées que vers le sommet.)—Fée, l. c.

Rhizome creeping, woody, 2 mm thick, paleae 2 to 3 mm long, brown, firm, ovate, fixed above the broadly rounded or cordate base; stipes approximate or up to 5 mm apart, 1 to 3.5 cm long; lamina up to 20 cm long and 18 mm wide, often much smaller, herbaceous, glabrous except for sparse and deciduous setae on margin and costa, attenuate, entire or somewhat irregular.

Venation irregular, veins most commonly forked well or far above the costa, both branches elongate, the sorus terminal (or rarely subterminal) on the acroscopic veinlet; but in broad fronds the sterile veinlet may fork again close to the margin; and in narrow fronds the fertile veinlet may be obsolete, the sorus terminating the simple vein. Sori superficial, extramedial or submarginal, receptacle elongate, sorus round or somewhat elongate, contiguous or not so, sporangia naked.

CEYLON: *C. P. 3074, Walker 110, Naylor Beckett 217,* in Gray Herbarium; *Wall,* in Herb. Univ. Calif.

131. GRAMMITIS WALLII (Beddome) Copel., comb. nov.

Polypodium Wallii Beddome, Supplement (1876) 20, *pl. 380.*

"Rhizome creeping scaly furnished with numerous thick black wiry roots, stipes 3–6 lines long scaly and hairy, fronds linear lanceolate with a blunt apex 3 inches long by ½ inch broad thick coriaceous, the veins quite hidden more or less furnished on both sides and on the margin with delicate black hairs, veins thick forked (or simple towards the apex of the frond) sori large round terminal on the superior veinlet and forming a regular row on each side of the fronds about midway between the costa and the margin. Ceylon, Central Provinces, this comes nearest to parasiticum, but is very much larger and of much thicker texture."—Beddome, l. c.

In Ferns Brit. India and Ceylon (1892) 305, Beddome repeats this, with added punctuation, and the same plate, reduced, and specifies Adam's Peak as the locality.

Rhizome short-creeping, 1 to 1½ mm thick, paleæ 1½ mm long ovate or lanceolate, obtuse or apiculate, brown, firm, naked; stipes 1 to 2 cm long, 0.6 mm thick, densely beset with brown hairs 1 mm long; lamina 4 to 5 cm by 7 to 9 mm (Beddome says 3 in. by ½ inch), rounded to subacute, cuneate at base, entire, coriaceous, margin short-ciliate, surfaces sparsely persistently setose, the dark hairs of the nether surface up to 2 mm long; veins forked far from the costa, the round sori completely occupying the short acroscopic branch; a few setulæ detected on sporangia, cells of the annulus 14.

CEYLON, Adam's Peak, *C. P. 3921*, the only reported collection, in Gray Herbarium.

132. GRAMMITIS SETOSA Blume

Grammitis setosa Blume, Enum. (1828) 116; Flora Javae II 116, *pl. 48, fig. 3.*

Polypodium setosum Presl, Tent. (1836) 180; v.A.v.R., Malayan Ferns 585; *nec aliorum.*

Grammitis pubinervis Blume, Enum. (1828) 116; Flora Javae II 117, *pl, 48, fig. 4.*

Polypodium pubinerve Christ, Ann. Jard. Buit. 15 (1897) 146, *quoad nomen.*

Grammitis longa Fée Genera (1850–'52) 233; 6e Mém. 6. *pl. 4, fig. 1.*

Polypodium sundaicum C. Chr., Suppl. III (1934) 160.

"G. frondibus stipitatis lineari-lanceolatis utrinque attenuatis sub-denticulatis venosis ad costam utrinque margine stipiteque setosis, soris rotundato-ellipticis approximatis, caudice repente.

"Obs. *Grammitis obtusa*, Willd. differt frondibus obtusis, venis simplicibus haud bifidis uti in hac specie.

"Crescit in arboribus Javae."—Blume, Enum.

"Stipes 1–1½–pollicaris, filiformis, canaliculatus, sordide fuscus, setis dispersis.

"Frondes valde congestae, . . . 3–6-pollicares, 3 lin. latae, . . . ad marginem costamque utrinque sub-elevatam setis nigrofuscis obsitae, venis parum conspicuis, quarum ramulus exterior bifurcus marginem fere attingit, alter vero brevior sorophorus est, coriaceae, saturate virides, opacae, siccitate fusecescentes.

"Sori a medio ad apicem . . . solitarii, costam inter marginemque dispositi, sibimet approximati, primum ovales, postea sub-rotundi, uti in *Polypodiis*, demum fere in lineam continuam confluentes."—Flora Javae.

The reduction of *G. pubinervis* (*pubinervia*) is indicated by Blume himself, Flora Javae 117. Apparent differences are "Frons 8–10 pollicaris, 4 lin. lata, illâ crassior, costâ, supra parumper, subtus fortiter prominulâ. Venae laterales similes, ast modo, ubi frondem obverteris, conspicuae"; otherwise so

alike that "magis adhuc nobis persuasum est, eam varietatem esse *G. setosae.*"

The types, in Herb. Lugd. Bat, are, respectively, Nos. 908,286 . . . 139, and 908,302 . . . 167. In my opinion, *G. pubinervis* is not a variety of *G. setosa;* it is simply that species in the full development of which every well situated normal individual is capable.

Grammitis longa Fée has been interpreted otherwise, but must surely be this species, the description fitting it well; and Fée's illustration of venation and sori could have been made from the type of *G. pubinervis.*

Rhizome short-creeping, paleae of strong plants 2 to 2.5 mm long, lanceolate to ovate, thick-walled; stipe 1 mm in diameter, narrowly winged in the upper part by the long-decurrent lamina, hairs more or less sparse, 1 to 1.5 mm long; veins once forked in small specimens, twice forked in well developed ones, ending under hydathodes; sori large, supra-basal on veinlets which usually extend a little beyond them, sporangia bearing short, dark setulae.

FIG. 94

JAVA: *Backer 31285, Swartz 3015, van Steenis 4133, Palmer* and *Bryant 872, 985 partim.* CELEBES: *Koorders 17096B.* BORNEO: Mt. Kinabalu, *Topping 1735* in Philip. Nat. Herb., sori slightly impressed. PHILIPPINES, Luzon: Mt. Pulog, *Merrill 6376 partim, Copeland s. n.*

The plant which I named *Polypodium setosum* var. *calvum,* Philip. Jour. Sci. 2C (1907) 136, is near this species but not identical. It is so unstable in various respects that, having only the one collection, I abstain from naming it again. The fertile veins are regularly once forked, or regularly twice forked, or mixed. The fertile veinlet may be just long enough to bear the sorus, but is oftener elongate, and the sorus is then basal, medial or terminal. Anastomoses are common, although the fronds are only 6 to 8 mm wide.

133. GRAMMITIS IMPRESSA Copel., sp. nov.

Rhizomate brevi-repente, 1.5 mm crasso, paleis obscuro-stramineis ovatis acutis 1–2 mm longis vestito; stipitibus approximatis non fasciculatis, 2–3 cm longis, 0.5 mm crassis, setis castaneis ca. 1 mm longis ornatis; lamina ca. 15 cm longa, 7 mm lata, utrinque angustata sed apice obtusa et basi decurrente, breviter sparse ciliata, faciebus setis

FIG. 95

paucis fragilibus 1.5 mm longis sparsis, tum demun glabrescente; costa inferne praestante, venis luce transmissa conspicuis, furcatis, venula basiscopica iterum furcata rarius bis furcata, venula fertile paullo supra sorum elongata; soris inframedialibus, brevi-oblongis, impressis et e facie superiore laminae notabilibus, loculis setis paucis protectis, sporangiis etiam setuliferis.

SUMATRA: Tapianoeli, "Mossy jungle on the upper slopes of Dolok Soeroengan (ascending from Pagar Batoe), Habinsaran." *Barlett 7964 A.* Type in U. S. Nat. Herb. *Bartlett 7964* is mostly *G. congener,* but the sheets in U. S. Nat. Herb. and Herb. Univ. Calif. both contain also the very different species here described.

G. immersa is in most respects like *G. setosa,* but conspicuously different in the feature which provides the name. In this respect, it resembles *G. loculosa* and *G. dictymioides,* of New Guinea, but the fertile depressions are smaller.

To this species I refer also a plant of Mt. Kinabalu, *Holttum 25871, Clemens 30738, 51367.* Its sori are distinctly impressed, though not so conspicuously as in the type. This was construed by Christensen and Holttum, Gardens' Bull. 7:294, as *G. obscura;* but the type of that species bears more and shorter hairs on the lamina, and its sori are superficial.

134. **GRAMMITIS CAVISORA** C. Chr.

Polypodium cavisorum C. Chr., Dansk Bot. Arkiv 9 5 (1937) 70.

"Grammitis rhizomate longe repente, paleis fuscis linearibus, fuscis, clathratis, distincte ciliatis vestito, folia 1 cm inter se remota ferente. Stipite perbreve vel subnullo, raro 1 cm longo, lamina anguste linearilanceolata, utrinque angustata, usque ad 50 cm longa, 1.5 cm lata, integra vel undulato-repandula, coriacea, laete virente, nervo mediano subtus et marginibus pilis rufo-brunneis brevibus saepe ramosis vel fasciatis sparse onustis mox denudatis, pagina inferiore pilis brevissimis erectis conspersa. Venis occultis, semel vel bis furcatis, ramo basali acroscopico sorifero; soris nervo mediano approximatis, utrinque in parte tertia apicale uniseriatis, profunde immersis, juvenilibus ovalibus, paraphysibus nullis.

"Borneo: Sarawak, Ulu Koyen (Mt. Dulit), Baram Valley, ca. 800 m., Sept. 25th. 1932, P. W. Richards no. 2065 (Oxford University Expedition to Sarawak 1932). 'Epiphytic on small mossy trees near ground in heath forest.' (Type).—Mt. Lingga, coll. by Dayaks 1909 (Herb. Bonaparte).

"In size, shape and texture exceedingly like *P. fasciatum* (Bl.) but quite different by its ciliate scales, sparsely pubescent fronds and immersed sori."—C. Chr., l. c.

I have seen a specimen in the Singapore Herbarium, and verified it as a distinct species, but thought it was unpublished and that notice of it on my part might be confusing; only

after its return to Singapore, my attention is called to its prior publication as a *Polypodium.* The open soriferous pits are like those of *G. impressa* and *G. loculosa,* but it is distinct in pubescence and otherwise.

135. GRAMMITIS NIGROSETOSA Copel.

Grammitis nigrosetosa Copel., Univ. Calif. Publ. Bot. **18** (1942) 224.

G. rhizomate ignoto; stipite (frondis unicae) 18 mm longo, 0.6 mm crasso, fusco, setis nigris plerisque vix 1 mm longis sat dense vestito; lamina 11 cm longa, 5 mm lata, obtusa, basi breviter attenuata, integra, subcoriacea, ad marginem dense et ubique haud sparse setis nigris validis usque ad 2 mm longis vestita; costa gracile, venis immersis, bis furcatis; soris parvis, superficialibus in seriem utroque latere costae unam inframedialem instructis, nec carent aliis margine propioribus sparsis, venula fertile acroscopica saepius supra sorum prolongata; setulis sporangiorum non visis.

FIG. 96

"N.W. Buru. G. Fogha, 1400 m. Haüfiger Stammepiphyt." II Freiburger Molukken-Expedition *no. 404, 1. Erwin Stresemann.* Ende Febr. 1912. Type in Herb. Lugd. Bat. No. 936,298 . . . 162. Det. by Rosenstock as *Polypodium diplosorum* Christ var. *setosa* (Bl.) C. Chr.

This is related to *G. setosa,* but not nearly to *P. diplosorum,* which is *G. pilosiuscula.* From the former, it differs conspicuously in its copious black setae. The presence of scattered sori on veins forked but twice is unusual. The sporangia are past maturity; when younger, they may be setulose. The base of the stipe is enlarged, suggesting that it is articulate to an elongate rhizome.

136. GRAMMITIS STRESEMANNII Copel.

Grammitis Stresemannii Copel., Univ. Calif. Publ. Bot. **18** (1942) 224.

G. rhizomate repente, paleis ovatis integris fuscis 2–3 mm longis imbricatis vestito; stipitibus inter se 6 mm remotis, 5 cm longis, 1 mm crassis, nigrescentibus, setis cinnamomeis 1 mm (rarius 1.5 mm) longis densissime vestitis; lamina (plantae unicae) 13 cm longa, 1 cm lata, integra, obtusa, basi decurrente, herbacea, margine costaque inferne setis sparsis atrofuscis 1 mm longis munita; venis conspicuis, bis furcatis, venulis sterilibus sub hydathodis a mar-

FIG. 97

gine remotis terminantibus; soris inframedialibus, ad venulas apicalibus, superficialibus, ellipticis.

"Mittel-Seram. G. Sinaia. Epiphyt der Baumfarnregion (ca. 2530–2750 m.)" II Freiburger Molukken-Expedition *no. 268, 1 Erwin Stresemann.* Ende August 1911. Type in Herb. Lugd. Bat. No. 936,248 . . . 170, det. by Rosenstock as *Polypodium pubinerve* (Bl.) Christ, v. *tenuis* n. v.

As to its affinity, this seems to be correctly placed by Rosenstock, but it is unlike *G. setosa* in the position of the sorus,—on a veinlet considerably elongate below it,—and unlike any Malayan species in the densely shaggy stipe. The sori are immature, and would become less conspicuously elongate. There are no setulae on the young sporangia, but they might develop later.

137. GRAMMITIS OBSCURA Blume

Grammitis obscura Blume, Enum. (1828) 115; Flora Javae II 113, *pl. 50, figs. 1–2.*

Polypodium obscurum Mett., Polypodium (1857) 38; C. Chr. Suppl. III 154.

P. Reinwardtii var. *obscurum.* C. Chr. Index 549, 552.

"G. frondibus stipitatis lineari-lanceolatis obtusis leviter repandis coriaceis aveniis planis ad costam utrinque margine stipiteque pubescentibus, soris oblongis obliquis, caudice repente. (In Flora Javae, this reads "subrepente").

"Obs. G. *lanceolata,* Sw. frondibus acuminatis nudis discrepat.

"Crescit in Javae sylvis supra arbores."—Blume, Enum.

"Habitat: Altitudine 7000 ped, inter montes Gedé et Pangarangu ad radices arborum vetustas muscosas a nobis reperta. G. *hirtae* simillima videtur differre venarum structura subsimplice (in illa ramosa).

"Filix magnitudine admodum varians, 4–8-pollicares.

"Caudex reptans, . . . ad . . . maximam partem paleis parvis scariosis pallide fuscis laceris ornatus . . ."

"Frondes stipite ½–1½ pollicari tenero pubescenti-hirto suffultae, erectiusculae, 3½–6-pollicares et altiores, 4–6 lin. latae, lineari-lanceolatae, obtusae, inferne attenuatae, integerrimae vel leviter repandae, planae, costa utrinque distincta, subtus plano-convexa, aveniae, ast lumini obversae venis lateralibus simplicibus aut bifidis, marginem non attingentibus, ramis apice sub-clavatis, superiore brevissimo, coriaceae, margine costaque utrinque pilis nigro-fuscis hirsutulae, saturate virides, vix nitidae, exsiccae fuscescentes.

"Sori sub-oblongi aut ovales, utrinque costae approximati, sub-oblique. sulcis frondis admodum superficiariis vix distinguendis insidentes.

" β . Angustata; frondibus angustioribus sub-integerrimis breviter stipitatis utrinque sub-pubescentibus, soris sub-rotundis confluentibus . . ."—Blume, Flora Javae.

Herb. Lugd. Bat. sheet No. 908,286 . . . 140 is Blume's type. The species is represented by one other defective specimen, which can hardly be the var. *angustata.* The rhizome of the

type is short and stout, bearing two fronds. The one entire frond matches the figure in Flora Javae perfectly; 15 cm long, on a stipe 3 cm long, 0.7 mm thick, pilose with weak hairs 1 mm long; lamina glabrescent with the passing of a century, but with enough setulae still present to show that the costa and margin were once fairly densely beset with bristles about 0.3 mm long, coriaceous, opaque until cleared; veins forked, the basiscopic veinlet forked again in the broader part of the frond; sori elongate, occupying all but the base of the fertile veinlet, which is not as short as in *G. Reinwardtii;* sporangia bearing dark setulae; paleae brown, firm, 1 to 1½ mm long, ovate-lanceolate.

FIG. 98

138. GRAMMITIS MARIVELESENSIS Copel.

Grammitis marivelesensis Copel., Univ. Calif. Publ. Bot. **18** (1942) 224.

G. caudice breve, erecta, paleis laete brunneis lanceolato-ovatis 1.5–2 mm longis basilus stipitum occultis vestita; stipitibus dense fasciculatis, ca. 2 cm longis, gracilibus, nigro-fuscis, pilis castaneis ca. 2 mm longis vestitis; fronde 10–15 cm longa, 6–10 mm lata, apicem basinque versus angustata, integra, herbacea, marginibus dense et faciebus sparsius pilis rufo- castaneis 2–3 mm longis (nec carent ad marginem brevissimi immixti), setosa; venis plerisque bis furcatis ramo infimo plerumque supra sorum protenso; soris uniseriatis costalibus, orbicularibus, superficialibus, sporangiis setulis brunneis ornatis.

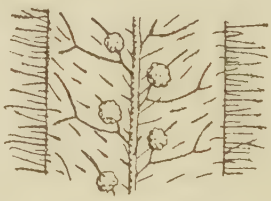

FIG. 99

LUZON: Mt. Mariveles, alt. 1,200 m, *Copeland 215,* type, January, 1904; *Pterid. Philip. Exsic. 70 partim. No. 70* is unmixed *G. marivelesensis* in some herbaria, but in others contains also *G. jagoriana;* it was distributed under the latter name. A mixture distributed by the Bureau of Science as *Polypodium parasiticum* Mett., *Loher 13486,* from Paningtingan, Rizal, is in part *G. marivelesensis.* Tayabas, *Disdon* in Gray Herbarium.

A local derivative of *G. fasciculata,* with shorter stipe with shorter hairs, relatively narrow frond, and the texture not spongy.

139. GRAMMITIS PILOSIUSCULA Blume

Grammitis pilosiuscula Blume, Enum. (1828) 115; Flora Javae II 107, *pl. 46, fig. 2.*

Polypodium pilosiusculum Presl, Tent. (1836) 180.

Grammitis hirta Blume, Enum. (1828) 115; Flora Javae II 111, *pl. 47, fig. 1, non* H. B. K.

Polypodium hirtum Presl, Tent. (1836) 180; Hooker, Sp. Fil. IV 170 *quoad nomen, non aliorum.*

Polypodium diplosorum Christ, Verh. Nat. Ges. Basel **11** (1896) 440; Ann. Jard. Buit. **15** (1897) 146.

"G. frondibus stipitatis linearibus obtusiusculis subrepandis coriaceis aveniis untrinque stipiteque pilosiusculis, soris ellipticis raris, caudice repente paleaceo.

"Obs. *G. obtusa* Willd. differre videtur frondibus margine modo setosis.

"Crescit in arboribus Javae."—Blume, Enumeratio.

"Habitat: Possidemus specimen unicum . . . ad . . . Gedeh lectum . . .

"Filicula 3–4-pollicares, in arborum cortice parasitica.

"Caudex repens, paleis membranaceis, ovato-obtusis, integerrimis, glabris, sub-rugosis, flavido-fuscis . . . obtectus . . .

"Stipes ½–1-pollicaris, tenellus, filiformis, teres, ecanaliculatus, sordide fuscescens.

"Frondes caudici supra serie simplice impositae, circiter ½ lin. inter sese distantes, erectae aut sub-arcuato-adscendentes, 2½–pollicares aut breviores, 3 lin. latae vel angustiores, lineares seu potius angusto-lanceolatae, apice obtusae, basi attenuatae, margine exigue repandae, nunc planae, nunc marginibus revolutis et subimet applicatis, coriaceae, aveniae, costa subtus prominula, utrinque, aeque ac stipes setis sparsis saturate ferrugineis vestitae.

"Sori parvi, ovales, circa 5–6 in fronde inter costam marginemque dissiti, sub-obliqui, vix immersi, post capsularum lapsus maculas nigras linquentes."—Blume, Flora Javae.

Blume's *specimen unicum,* somewhat damaged, is Herb. Lugd. Bat. sheet No. 908,304 . . . 372. With the exception of a sheet of *G. attenuata* from Ceylon, this is the only sheet I have found in any herbarium bearing this name. It is well depicted in Flora Javae. In one respect, the drawing improves on the description,—the rhizome is very short, with only three fronds; it is inaccurate in showing dense instead of sparse hairs on the stipe. The individual is either juvenile or depauperate, as shown by the few fronds and sparse sori; but the fronds are old, the sporangia gone, as was evidently so when it was described.

FIG. 100

The ovate paleae are 1.5 mm long; the surviving hairs on the stipe a scant millimeter, on the lamina a full millimeter long, reddish-fuscous; veins forked, the basiscopic branch again forked in the broader part of the frond. The small, oblong receptacle is above the base of its veinlet, which is prolonged a little above the sorus; sorus slightly impressed. To repeat the positive information: Rhizome short, with small, ovate paleae; stipe and lamina persistently but sparsely setose; veins more than once forked; sorus above the base of its veinlet, slightly impressed. This should suffice for the approximate recognition of the species, identification to be confirmed by comparison as to details.

We have here a case duplicating that of *Hymenophyllum emarginatum* Swartz, Copeland, Hymenophyllum 119. Neither Thunberg nor Blume was likely to begin the exploration of Java by finding a species too rare to be found again in a century of intensive collection. Yet, van Alderwerelt, Malayan Ferns 580, did not know *G. pilosiuscula,* and had to be content with translating Blume; and its identity is a matter of speculation by Backer and Posthumus, Varenflora 192.

Presuming that *G. pilosiuscula* is no rarity, but is known under another name, I have examined the recognized species in the order of their priority, this having priority over all in Java except *G. caespitosa,* distinguished by immersed sori. Number 3 in the Enumeratio is *G. congener,* distinguished by velutinous stipes, the pubescence dense but so short that it does not appear in the illustration in Flora Javae. Number 4 is *G. hirta.* Blume distinguished this from *G. congener* by "frondibus repandis utrinque hirtis," but did not compare it with *G. pilosiuscula.* From Flora Javae 111, pl. 47, fig. 1, we learn that it is a much larger fern. The illustration shows also a considerably more hairy stipe and margin. What seems to be the type of *G. hirta,* Herb. Lugd. Bat. sheet No. 908,301 . . . 11, is now hardly more than a wreck. It bears the base of a large young frond, with pubescence as illustrated, crenate margin, veins 4-times forked, a sorus on one of the basiscopic veinlets; and part of an old frond exactly like the type of *G. pilosiuscula* except that the stipe is not so sparsely hairy. The paleae, and the position of the sori, dorsal on their veinlets, are the same; and so is the character of the pubescence.

By its own evidence, the type of *G. pilosiuscula* is a juvenile or depauperate plant with old fronds, which, with age before

collection and a century in the herbarium, must have lost many hairs. In better development, the species should have numerous and larger fronds. The larger fronds would be expected to have more veinlets (since the veins are twice forked on the small fronds of the type); and accessory sori, indicating or forming a second row, are common in species of *Grammitis* having veins forked several times (pinnate). I have no doubt that the types of *G. pilosiuscula* and *G. hirta* represent a single species, which must bear the former name although better described as the latter.

"Frondes valde congestae, stipitatae, 6–pollicares (in β nonnumquam 8-pollicares), vix 3 lin. latae (in β 5 lin.), . . . magis minusve revolutae, coriaceae, . . . utrinque setis multis atro-fuscis . . . Venis laterales pinnatae, solum fronde luci obversa distinguendae, in β tamen quidquam magis conspicuae.

"Stipes circiter pollicaris vel aliquantulo longior, pilis longis, multis patentibus, saturate ferrugineis hirtus, in β glabrior.

"Sori numerosi, irregulares, . . . costae magis minusve approximati abeâdemque oblique distantes, . . . vix immersi."—Flora Javae 111.

Variety β is typified by Herb. Lugd. Bat. No. 908,302 . . . 166, confused in the herbarium with *G. pubinervia*. It is now persistently opaque, but the venation is distinctively that of *G. hirta*, the veins forked as many as four times. *G. setosa* is commonly larger than *G. pilosiuscula;* comparing plants of the same size, large or small, it is distinguished by fewer, darker, longer and stouter hairs, large sori, and less divided veins.

JAVA: *Zollinger 1718* (Idjen), *Burck 86, Hancock 53a partim, Raciborski* (Gedeh and Slamat), *Palmer* and *Bryant 191* (one plant may be *G. congener*), *985 partim.* SUMATRA: *Bünnemeyer 9777 partim.* CELEBES: *Bünnemeyer 12070.*

140. GRAMMITIS HAVILANDII (Baker) Copel.

Grammitis Havilandii (Baker) Copel., Genera (1947) 211.
Polypodium Havilandii Baker, Linn. Soc. Trans. Bot. 4 (1894) 253; Christensen and Holttum, Gardens' Bull. 7 (1934) 296.
Polypodium multisorum Copel., Philip. Jour. Sci. 12C (1917) 61.

"Caules caespitosi, graciles, subpollicares, pilis subtilibus, mollibus, patentibus tenuiter vestiti; lamina simplex, lanceolata, subcoriacea, utrinque pubescens, 2–3 poll. longa, medio 3 lin. lata, ad basin et apicem sensim attenuata, margine obscure crenata; venae obscurae furcatae. Sori oblongi, obliqui, uniseriati, laxe dispositi, ad costam contigui.

"At 10,500 feet (*Haviland,* 1488)."—Baker, l. c. (Mt. Kinabalu).

Rhizome short, ascending, paleae suppressed on luxuriant plants, or (on plants with few fronds) 2 to 3 mm long, lanceo-

late, obtuse, ferruginous; stipes usually densely fascicled, 2 to 6 cm long, densely hirsute with tawny hairs commonly 2 mm, sometimes 3 to 4 mm long; lamina 15 to 25 cm long, about 1 cm, wide, attenuate to both ends, sinuate-crenate on strong plants, densely pubescent and hirsute, hairs ferruginous, often clustered; veins several times forked; sori scattered in several irregular rows, variously placed on the veinlets, superficial, those nearer the margin roundish, the others elongate, sometimes even linear; sporangia bearing pale hairs of some length and mixed with longer ones forming dense, persistent tufts or lines.

FIG. 101

Known only from Mt. Kinabalu, alt. 2,500 to 3,000 m: *Topping 1665* (type of *P. multisorum*), *1668, 1682, 1711 Clemens 27995, Holttum 25478.*

An exceptionally distinct species.

I described the paleae of *P. multisorum* as wanting because dissected into hairs, and Christensen found the rhizome "apparently scaleless." This is the case when the denseness and hairiness of the stipes are extreme (commonly); and the same effect is approached by *G. fasciculata* in luxuriant development. But an unnumbered collection by Mrs. Clemens has few fronds and copious, well developed paleae.

141. GRAMMITIS FREDERICI ET PAULI (Christ) Copel., comb. nov.

Polypodium Frederici et Pauli Christ, Fil. Sarac. (1896); Ann. Jard. Buit. **15** (1897) 148, *pl. 16, fig. 21.*

"Gehört zu denselben, polymorphen und als Ausdruck der Nebelregion des Monsun-Clima so deutlich characterisierten Gruppe von Eupolypodien mit zungenförmigen Wedeln und langen Haarkleide, wovon P. setigerum Bl. die bekannteste Form ist, zeichnet sich aber durch besondere Grösse und mehrfache Sorenreihen sehr aus.

"Wedel gebüschelt zu 5 oder 6 aus dem kurzen braunschuppigen Rhizom. Stipes aufrecht 5 cm. lang, steif, kastanienbraun, dicht mit 3 mm. langen dunkeln abstehenden Haaren bekleidet. Wedel mit kürzen Haaren gewimpert und auf beiden Seiten damit dünn besetzt. Wedel 15 bis 18 cm. lang, oval-lanzettlich, 1.8 cm. breit, nach oben in eine schmale aber nicht scharfe Spitze, nach unten ähnlich verlaufend, durchaus nicht herablaufend oder geflügelt; Mittelnevy hervortretend, Seitennerven im Zickzack gebogen, beiderseits mit 3 bis 4 Aesten, die in ein verdicktes Ende ausgehen. Die runden, rot-braunen Sori sitzen an diesen Enden der 3 bis 4 untern Nervenäste, und bilden unregelmässige vierfache Längsreihen auf jeder Seite des Mittelnervs; sie sind nicht eingesenkt. Textur häutig, dünn, Farbe grün, unten blasser, Rand eingezogen. Die grösste Art ihrer Gruppe.

"Loc. S. 1364. Wawo-karaeng, Gipfelregion, 2000 m."—Christ (1897).

Known to me by *Bünnemijer 11072, 11949, 12067, 12420* in Herb. Lugd. Bat., *12067* in Herb. Singapore, from N. W. Celebes, alt. 2,000 m. The identification is positive. Rhixome 3 mm thick, covered with large scars of fallen fronds; paleae 3 mm long, lanceolate, tawny, strongly ciliate, —like those of *G. calcipunctata*. The weaker veins are zigzag, as described and figured, but the stronger ones are practically straight. The veinlets from adjoining veins anastomose here and there, in the manner of *Goniopteris*.

FIG. 102

142. GRAMMITIS CALCIPUNCTATA Copel., comb. nov.

Polypodium calcipunctatum Copel., Philip. Jour. Sci. **12C** (1917) 61; Christensen and Holttum, Gardens' Bull. **7** (1934) 297.

"Grammitis P. Frederici et Pauli Christ affinis, subglabra et punctulis calcareis ornata; rhizomate erecto, paleis lanceolatis fulvis dense ciliatis vestito; stipitibus confertis, 3 at 4 cm longis, gracilibus, pilis 2 ad 2.5 mm longis pallidis et rubis vestitis; fronde pendente, usque al 25 cm longa, ca. 13 mm lata, linguiforme, subacuta, deorsum angustata, integra vel rarius obscure et late crenulata, crassa, superne glabrescente st ad apices venularum albo-punctata, inferne sparse pilosa; venis utrinque pinnatis, immersis; soris irregulariter a costa fere ad marginen adspersis, superficialibus, orbicularibus, inter sporangia pilis paucis.

"Mount Kinabalu, Kemberanga, *Mrs. Clemens 10530.*

"While near to *Polypodium Frederici et Pauli* of Celebes, this fern has a narrower frond, with parallel sides and the form of a narrow *P. setigerum*, less conspicuous and almost naked costa, and thicker texture."—Copeland, l. c.

As noted by Christensen and Holttum, this can become considerably larger, up to 40 cm long; large, strong fronds are broadly crenate. The stipes are dilated at the base and abscissent, leaving conspicuous scars on old rhizomes.

This is nearly related to *G. Frederici et Pauli*, the differences being, as stated in the original publication, in form and texture of frond. Judging by the limited number of collections, the venation of *G. calcipunctata* is more lax, and anastomosis of the veinlets is correspondingly rare; where it occurs, a lime dot

marks the point. These lime dots are not wanting on *G. Frederici et Pauli.* The two species are alike, and unlike any known relatives, in the conspicuously ciliate paleae.

Specimens seen: The type collection, in my own herbarium; *Clemens s. n., Holttum 25480* in Herb. Singapore; *Holttum 25532* in several herbaria. Christensen and Holttum cite also *Gibbs 4141.* All are from Mt. Kinabalu.

COMMENT ON MALAY-ASIATIC GRAMMITIS

In spite of its wealth of species, the Malay region is a colony of New Guinea. When we were young who are no longer so, we sought to explain the source of the Philippine flora. With what may be regarded now as lack of reason, we were influenced by the facts that many of our species were first described in Java, and that Java still had a much richer known flora than the Philippines; and, half unconsciously, when we found in the Philippines a fern long known in Java, we regarded it as a Javan fern, a probable immigrant from Java. Early in such study, we were surprised by the number of such species common to Celebes also, and were disposed to conclude that the route from Java by Celebes had been a better one than that by Borneo. As to the ferns, this was surprising, because, of all the great Malayan islands, Celebes was already believed to be at present the least favorable climatically for ferns. New Guinea was not then taken into account.

We have never overlooked the fact that our conclusions were based on what we knew, and that what we had still to learn might upset our judgments. It is well to have this fact always in mind. But the evidence is now substantial enough so that I present the New Guinea origin of Malayan *Grammitis* as a fact, rather than as any tentative conclusion. Instead of being surprised by species common to Mindanao and Celebes, we now regard them as matters of course.

By its position, Celebes should be the Malayan island richest in this genus, but it does not seem to be so. Possibly, this is because it is not as well collected as Mindanao and Java. More probably, it is really not so rich, and, if this is so, the reason is probably that it is less humid.

The Malayan species are without any general structural distinction from those of New Guinea, except, as already mentioned, that the fronds are more generally clustered. As in New Guinea, setulose sporangia are almost universal except in the group of *G. fasciata.*

Subgenus Melanoloma Grammitidis laminis nigro-cinctis distinctum

Most veins forked, fertile branches elongate.
Stipe short (up to 6 mm) ..... 143. *G. marginella* (W. Indies, etc.)
Stipe elongate (2 cm or more).
Branched hairs wanting.
Base of lamina long-decurrent ..... 144. *G. leptopoda* (S. America)
Base of lamina short-cuneate ..... 145. *G. pseudomarginella* (Madagascar)
Branched hairs present on stipe ..... 146. *G. kyimbilensis* (E. Africa)
Sterile veins simple, fertile veinlets short.
Fronds about 1 cm long ..... 152a. *P. microglossum* (Madagascar)
Fronds 2–3 cm long ..... 152. *G. melanoloma* (Reunion)
Well developed fronds much longer.
Paleae 2–4 mm long.
Veins conspicuous beneath, paleae yellowish-brown ..... 147. *G. limbata* (W. Indies)
Veins inconspicuous, paleae not yellowish.
Veins at angle of 30° or more.
Fronds rather opaque, strongly bordered.
Fronds over 10 cm long .....148. *G. fluminensis* (Trop. America)
Fronds 3–5 cm long .....149a. *P. haplophlebium* (Venezuela)
Fronds thinner, border narrow.
Frond narrowed below apex ..... 149. *P. Hessei* (W. Indies)
Apex rounded or cuspidate ..... 150. *P. bryophilum* (Costa Rica)
Veins at a very acute angle ..... 151. *G. quaerenda* (Atlantic Ids.)
Paleae 8–9 mm long.
Large fronds 30 cm by 5 mm ..... 153. *G. Vaupelii* (Samoa)
Large fronds 15 cm by 7 mm ..... 153a. *P. marginelloides* (Polynesia)

143. GRAMMITIS MARGINELLA Sw.

Grammitis marginella Sw., Schrad. Jour. 1800[2] (1801) **17**; Syn. Fil. (1806) 22; Schkuhr, Krypt. Gew. 8, *pl. 7.*
Polypodium marginellum Sw., Prod. (1788) 130.
Mecosorus marginellus Kl., Linnaea **20** (1847) 405 *quoad nomen.*

"Frondibus cuneiformibus linearibus obtusis marginatis glabris. Fructificationibus solitariis confertis, surculo brevissimo nudo.

"Jamaica."—Swartz (1788).

"Frondibus lanceolato-lingulatis fusco-marginatis, stipitibus brevissimis subciliatis.

"Jamaica, Ins. St. Helenae."—Swartz (1806).

Paleae (overlooked by Swartz, noted by Schkuhr) 3 mm long, lanceolate, acuminate with an elongate deciduous apical cell, brown with darker apex; stipes fascicled, usually very short, rarely (in luxuriant specimens) up to 2 cm long, bearing weak brown hairs 0.3 mm long; lamina up to 12 cm long and 9 mm broad usually smaller, oblanceolate, attenuate downward, rounded at apex, subcoriaceous, narrowly black-bordered, persistently short-ciliate, the nether surface less persistently hairy with fragile hairs, the young sori protected by a few long ones; veins furcate except near the base of the frond, both branches elongate but not to the border; sori elliptic, near the bases of the acroscopic branches, subcostal, commonly present from the apex to below the middle of the frond; cells of the annulus, as stated by Schkuhr, about 11.

FIG. 103

JAMAICA, common: *Jenman, Underwood 1518, 2494, 3190, 3200, E. G. Britton 1137, Maxon 1476, 2709, 9779, 9954, 10222 Maxon* and *Killip 1158;* Haiti, *Ekman H 7549,* conforming sufficiently to the Jamaican type.

At this point, with the cited Jamaican specimens as a basis, I would comment in detail on the venation. Typically, the fertile veins are once forked, as are most sterile veins also where the fronds is not narrowed. Sterile acroscopic branches do not usually approach the margin quite as nearly as do the basiscopic. On broader parts of fronds, it is common for the basiscopic branch to fork near the midrib, with two widely divergent branches; and anastomosis of these branches of adjoining veins is no rarity. Less commonly, the acroscopic branch anastomoses, usually with the basiscopic branch of the same vein. The fertile branch may be prolonged like a sterile one, may even fork again; but more commonly it is more or less shortened; and it may end with the elongate sorus. If it be shortened, and the basiscopic branch of its vein anastomose with a branch of the next higher vein, the resulting venation-pattern

is definable as Goniophlebioid; as a casual occurrence, this is almost common in the species.

After this digression, it is to be noted that, while Maxon knew no continental *P. marginellum* in Bull. Torrey Bot. Club 42 (1915) 221, he has since so identified a series of Costa Rica specimens.—*Lankester s. n., Valerio 62, 62a, Standley* and *Valerio 48175, 48200, 50477, 50576, 52148, Brade 124.* These differ uniformly from Jamaica specimens in that no fertile veinlets are prolonged appreciably beyond the sori. Also, the paleae are narrower and rather more attenuate (in this comparison, one must use plants of about the same size). However, these Costa Rica specimens are decidedly nearer to this than to any other species, and I let the identification stand.

Because it was the first, and long the only species described with black border. *G. marginella* has been accredited to every land where the group is represented. Nearly all of these indiscriminate reports are taken care of as I cite the responsible collections under other species. Only Bonaparte, Notes Pterid. I (1915) 64, reports this where it is not to be expected and no similar species is known: "Golfe de Guinée. A la base du Pic Calombey. 800 métres d'altitude. Sur les grands arbres dans la forêt. Juin 1891. Legit Francis Newton."

144. GRAMMITIS LEPTOPODA (Wright) Copel., comb. nov.

Polypodium leptopodon C. H. Wright in Baker, Linn. Soc. Trans. Bot. 6 (1901) 83.

"Ad *P. marginellum* Sw. accedit; differt fronde membranacea, marginibus ciliatis, venis unifurcatis, stipite elongato tenui piloso.

"Rhizome shortly creeping, 2 lin. in diam., with brown lanceolate scales near the apex. Frond oblanceolate, obtuse, up to 2 in. long by 3 lin. broad, glabrous except for a few cilia on the margin when young, edged with a black line; veins once forked, conspicuous; sori few, near the apex of the frond, often confluent; stipe up to 2½ in long, slender, pilose.

"Summit of Roraima, 8600 ft. *McConnell & Quelch*, 569."—Baker, l. c.

Hitherto known only by the original collection, the type in Kew, represented also in the U. S. Nat. Herb, and Herb. N. Y. Bot. Garden. Paleae 3 to 4 mm long, lanceolate-aciculate, yellowish-brown at base, atrocastaneous near the apex; stipe 1.5 to 5 cm long, very slender, clothed with inconspicuous pale-brown hairs 0.2 long, deciduous near the base, caducous upward; lamina 1.5 to 4 cm long, 3 to 5 mm broad, attenuate downward, broadly rounded at apex and the border sometimes forming a short point, subcoriaceous, glabrous at maturity, black-bordered;

veins standing at a wide angle, forked except in the narrow lower part of the frond, both branches elongate, not reaching the border; sori near the apex, few, confluent at maturity, receptacles elliptic, at or near the bases of the acropetal branches; cells of the annulus 11 to 13.

As known by the single collection, this would seem to be a remarkably distinct species, like *G. marginella* in venation, more like *G. fluminensis* in nakedness and texture, longer-stipitate than any other American species. The long stipes of the larger specimens are indeed very conspicuous; but the same collection includes fruiting fronds with stipes only 1 cm long. After identifying as *G. fluminensis* specimens with sessile fronds and with stipes up to 10 cm long, I regard the stipes of this group as very plastic structures, and identify as *G. leptopoda Fendler 256, prope Coloniam Tovar,* in the Gray Herbarium. Its stipe is slightly more hairy than that of Roraima specimens, and a few broken hairs persist on the margin, but its nakedness is in marked contrast with the hairiness of *G. marginella.* The two species are related, alike in typical venation, and distinct in this respect from all other American species of the group.

145. GRAMMITIS PSEUDOMARGINELLA (Bonap.) Copel., comb. nov.

Polypodium psudomarginellum Bonaparte, Notes Pterid. X (1920) 150.

"Rhizome court, dressé.

"Pétioles grêles jusqu'a 0^{m},02 de long. Couverts de poils mous épars étalés au moins sur les plantes jeunes.

"Frondes en touffes, ayant jusqu'a 0^{m},10 de long. Limbes jusqu'a 0^{m},08 de long sur 0^{m},004 de large, linéaires, à bords paralleles, arrondis au sommet, en coin dissymmétrique à la base. Cordon marginal noir tout auteur du limbe qui est roulé en déssous. Les deux surfaces sont glabres. Consistance subcoriace. Rachis saillant sur les deux faces, penné. Nervures secondaires libres, très obliques, furquées près de leurs bases, puis souvent de nouveau leurs branches primaires sone également furquées. Ces nervures fort visibles sont saillantes.

"Sores allongées, type grammitis, puis ronds, au milieu de l'espace séparant le rachis du bord de la fronde; à leur complet dévelopement, ils occupent toute la longueur de cet espace; une rangée de chaque côté du rachis dans les deux tiers supérieurs du limbe.

(Madagascar) "Région floristique du Centre. Ankaiziu. Entre 1200 et 2000 mèters d'altitude. (Perrier) No. 7469."—Bonaparte, l. c.

"A very distinct species, like *P. microglossum* a member of the group of *P. marginellum,* marked by the long hairy stipe, the linear oblong lamina with sclerotic black, ciliate margins and furcate veins."—C. Chr., Pterid. of Madagascar (1932) 150, *Pl. 56, figs. 3, 4.*

Reperesented in the U. S. Nat. Herb. by a fragment of *Perrier 7705,* from the type locality. The paleae are only 1 mm long, but there might be larger ones on a more ample specimen.

Reimers, Notizbl. Berlin **11** (1933) 930, proposed to reduce this species to *G. kyimbilensis,* and Christensen, Suppl. III 156, was disposed to agree with him. They are indeed very similar, and I have little confidence in the difference in size of the paleae of the fragments in hand. Also, simple hairs on the stipe are alike. But I can find no forked hairs on *G. pseudomarginella,* and this feature of *G. kyimbilenses* is remarkable enough to justify treating the two species as distinct.

146. GRAMMITIS KYIMBILENSIS (Brause) Copel., comb. nov.

Polypodium kyimbilense Brause, Bot. Jahrb. 53 (1915) 431; Reimers, Notizbl. Berlin **11** (1933) 929.

"E *P. marginelli* Sw. affinitate. Rhizoma breve, erectum, paleis fuscis e basi rotundata deltoideis, acuminatis, ad apicem versus leviter dentatis, 1 cm longis, 0.4 mm latis instructum. Folia fasciculata, petiolata, 6–15 cm longa. Petioli basi paleis rhizomatis circumdati, 3–4.5 cm longi, 0.5–0.8 mm crassi, siccitate glandacei, teretes, angustissime alati, pilis articulatis furcatis rufescentibus armati. Lamina coriacea, nitidula, usque ad 14 cm longa, 0.5–0.8 cm lata, ambitu lineari-lanceolata, in apicem obtusiusculum desinens, undulata, brunneo-marginata, juventute infra margineque pilis stellatis rufescentibus praedita, supra subglabra. Nervus medianus pilis articulatis refescentibus ornatus. Nervi laterales vix conspicui, furcati, interdum anastomosantes, nec laminae marginem attingentes nec apice incrassati. Sori ramo antico impositi, non immersi, superiorem laminae mediam partem occupantes, usque ad 18-jugi, remoti, sporis albidis, tetraedricis, verrucosis.

"Deutsch-Ostafrica: Kyimbila, Regenwald, auf Bäumen zwischen Moos, Blätter hellgrün, mattglänzend, Blattstengel braun, behaart, 1700 bis 2200 m. ü. M. (A. Stolz n. 1028—13 Dec. 1911)."—Brause, l. c.

By the courtesy of Director Diels, I am able to examine a fragment of the type. This fragment is too old to show the pubescence of the lamina, but Reimers has described this in more detail than Brause. I find the description perfect except in one respect, so significant that a misprint may be its explanation:—the paleae do not exceed 3 mm in length.

Fig. 104

As emphasized by Reimers, the apparent affinity is to *G. marginella,* among American species, as indicated by the forked veins and the pubescence. But this apparent affinity is not too strong to leave me believing that the East African species represent an independent migration from the South. The hairs

on the stipe are mostly simple, but scattered through them are forked hairs, and rarely hairs forked more than once.

The species is known by the type collection, and by one collection in the Uluguru mountains, Tangayika reported by Reimers.

147. GRAMMITIS LIMBATA Fée

Grammitis limbata Fée, Genera (1850–'52) 253; 6me Mém. 6, *pl. 5, fig. 1.*

Polypodium limbatum Maxon, Bull. Torrey Club 42 (1915) 222.

"Frondibus fasciculatis, linearibus, obtusiusculis, undulatis; nervillis simplicibus, tenuibus, marginem non attingentibus, mesoneuro tenui; margine linea aterrima lucidula notato; sporotheciis ovoideis, centralibus; receptaculo elliptico; sporangiis rotundis, parvis; annulo 12–13 articulato; sporis nigrescentibus, inaequalibus, rotundis.

"Habitat in insula Guadalupa. (Perrotet.)

"(Dimensions: longueur des frondes, 10–11 centim., sur 5–7 millim. de largeur; les sporothèces, assez rapprochés, sont cependant toujours distincts ; ils occupent le tiers supérieur de la fronde, sans en atteindre le sommet.)"—Fée, l. c.

". . . The sori, while nearly medial upon the veins, are not borne midway between the midvein and margin, owing to the basal curvature of the veins. The relatively pale scales, ligulate form of the exstipitate fronds, broad marginal band, and position of the sori at once distinguish it from its nearest ally, *P. Hessei.*"—Maxon, l. c.

The Gray Herbarium contains an excellent specimen identified by Fée, *L'herminier 103,* from Guadeloupe. It is very like *G. fluminensis* in appearance, except that, in spite of coriaceous texture, the veins are singularly conspicuous. This is true also of *Duss 4072,* the subject of Maxon's study, which has more ligulate, thinner fronds. The paleae of the L'herminier specimen are castaneous, considerably darker than those of the Duss specimens. Maxon correctly refers here also a St. Vincent specimen, *Eggers 6857* in part.

FIG. 105

A peculiar Guadeloupe specimen in Herb. N. Y. Bot. Garden, ex Herb. Cosson, has long-stipitate fronds with some fine hairs on the stipe; a part of the veins forked near the margin, and some even anastomosing. The fertile veinlets are not elongate beyond the sori, which makes me regard it as an abnormal form of *G. limbata,* rather than of *G. marginella.*

G. limbata seems to me to be a moderately distinct local relative, derivative or variant of the wide-spread *G. fluminensis.*

If combined, they would of course take the older name, *G. limbata.*

148. GRAMMITIS FLUMINENSIS Fée

Grammitis nigro-limbata Spruce in Hooker, Sp. Fil. IV (1862) 164, *nomen.*

Grammitis fluminensis Fée, Crypt. Vasc. Bras. I (1869) 85.

Polypodium nigrolimbatum Jenman, Bot. Dept. Jamaica Bull. II 4 (1897) 69; Maxon, Bull. Torrey Club 42 (1915) 223; Reimers, Notizbl. Berlin 11 (1933) 631.

"Frondibus linearibus, glabris, obtusiusculis, basi longe attenuatis, nervillis simplicibus, marginem non attingentibus, surculo, erecto; sporotheciis dimidiam partem frondium invadientibus, ovoideis, crassis, costalibus, approximatis, erectis; sporangiis rotundis, longe pedicellatis, annulo 10-12 articulato; sporis globulosis.

"Habitat in Brasilia fluminensi (Glaziou no. 2456).

"Filix linearis, glabra, frondibus super surculum erectum, repens fibrillosumque congestis.

"Icon.: XIX, fig. 3.

"(Longueur: 18–20 centim. sur 8–9 millim. de largeur.)

"Cette espèce rappelle par les frondes et les sporothèces le *G. Magellanica,* Desv., mais la radication est tout à fait différente; le rhizome rampant qui existe ici manque dans la plante de Desvaux."—Fée, l. c.

A type fragment in Herb. N.Y. Bot. Garden is only a part of a frond, but suffices for the positive identification of *Mexia 4063,* Serra de Caparao, Esperitu Santo, not far from the type locality (*fluminensi,* in the region of Rio), of which good specimens are in the Herb. Univ. Calif. and Gray Herbarium, and enable me to confirm and amplify Fée's description.

Rhizome erect, stout, clothed with narrow, aciculose, castaneous paleae 3 mm long; fronds caespitose, very short-stipitate, up to 15 cm long and 9 mm broad, widest near the apex, and either somewhat attenuate or abruptly rounded, long-attenuate downward, coriaceous, glabrous, rather narrowly black-bordered; sterile veins simple, the fertile with an acroscopic branch completely occupied by the eliptic subcostal sorus.

FIG. 106

Schmalz 163, from Santa Catharina, distributed by Rosenstock Fil. Bras, as *P. marginellum* var. *brasiliense,* is a small, weak representative of *G. fluminensis. Tate 1058,* from Bolivia, in Herb. N. Y. Bot. Garden, is typical, but this collection in U. S. Nat. Herb. is somewhat aberrant.

Polypodium nigrolimbatum is typically a plant with narrower fronds, the larger ones commonly 10 cm by 5 mm, more attenuate to both ends, more stipitate, and with rather stronger border. Representative collections: Jamaica, *Maxon 2724, 2748, 9281, 9473, 9780; Costa Rica, Standley* and *Valerio 55255;* Mt. Duida, *Tate 480;* Mt. Roraima, *McConnell* and *Quelch 568, Tate 307, 420;* Bolivia, *Williams 1376, Tate 288. Cardenas 1258,* Bolivia, is intermediate between the typical forms. *Standley* and *Valerio 52240,* Costa Rica, has the lamina of typical *P. nigrolimbatum,* but elongate stipes, even up to 10 cm long.

Jenman reduced both *G. fluminensis* and *G. limbata* to *P. nigrolimbatum* because Fée's names were not susceptible of transfer to *Polypodium.* Maxon endorsed the transfer of the former, believing that the rounded apex of Fée's plant was abnormal. This is not the case; but I am still disposed to regard the two as forms of one wide-spread species.

As I leave it, this is the most wide-spread and variable species of the marginate group. By specific discrimination no finer than has been practiced in this group, I could recognize at least three species, here included:—the Brazilian *G. fluminensis;* the Jamaican and Porto Rican *P. nigrolimbatum* of Jenman; and one of Peru and Bolivia (to which the Roraima plants are nearest) with narrow fronds, which is probably the *G. nigro-limbatum* mss., mentioned by Hooker. *Lechler 2713,* in Herb. Lugd. Bat., from Sachapata, Peru, is the most extreme specimen seen; fronds 3 to 4 mm wide, veins at a very acute angle, very evident beneath. Reimers, Notizbl. Berlin **11** (1933) 930, has noted its resemblance to *G. quaerenda.*

148a. POLYPODIUM HAPLOPHLEBIUM A. C. Smith

Polypodium haplophlebium A. C. Smith, Bull. Torrey Club **58** (1931) 307.

As the short Latin diagnosis is repeated, with essential amplifications, in English, it will suffice to quote the latter.

"Epiphytic; rhizome suberect, slender (about 1 mm. in diameter), densely paleaceous on the young parts, the scales pale brown, lanceolate-acuminate from a slightly contracted base, 2-3 mm. long, about 0.3 mm. broad near the base, the cells small, irregularly arranged in about 10 longitudinal series (at the widest point) with delicate walls; fronds numerous, subcaespitose, the stipes subterete, short (less than 5 mm. in length), the lamina glabrous or sparingly pubescent with minute black hairs, oblong-linear, 3–5 cm. long, 3–4 mm. broad, the base narrowly attenuate, the apex subacute, the margins plane, entire, and thickened into a heavy dark border (uniformly 0.2 mm. broad); venation regular, the costa thickened, the veins somewhat conspicuous,

plane above, slightly raised beneath, subopposite, straight, spreading, 7 or 8 pairs per centimeter, of the sterile portion simple, of the fertile portion bearing a short ascending soriferous spur near the base; sori round (or slightly elliptic), about 1.5 mm. in diameter, often confluent, occupying the upper half of the frond, receptacles plane, elliptic, about 1 mm. in length, occupying the entire soriferous spur of the vein; sporangia crowded, subglobose, about 0.17 mm. in diameter, the stalks slender, about 0.3 mm long.

"Slopes and flats at Central Camp (Mt. Duida, Venezuela), 4,800 ft., *553*. A species of the section *Grammitis,* allied to *P. leptopodon* C. H. Wright, endemic to Mt. Roraima, from which it differs by having the rhizome scales narrower, the stipes shorter, the fronds oblong-linear rather than oblanceolate, the veins simple (the soriferous spur being only long enough to accomodate the receptacle) rather than bifurcate, and the soriferous portion not limited to the apical part of the frond. The leaf tissue of the old fronds often decays leaving a peculiar skeleton of the veins and thickened border."—Smith, l. c.

The type, in Herb. N. Y. Bot. Garden, comprises eight quite uniform plants. The stipes are subterete because winged almost to the base. The few complete apices are abruptly rounded, with a cusp formed by the border. Aside from the venation, the almost sessile fronds distinguish this sufficiently from *G. leptopoda.* But I mistrust that *G. fluminensis,* dwarfed by its environment, might develop in this form, and still demonstrate less plasticity than we ascribe to *G. Billardieri.*

149. POLYPODIUM HESSEI Maxon

Polypodium Hessei Maxon, Bull. Torrey Club 42 (1915) 223.

"Plants epiphytic, 8–14 cm. high, the fronds few, ascending, subfasciculate. Rhizome decumbent or short-creeping, 1–1½ cm. long, 2–3 mm. thick, sparingly radicose beneath, the small apical portion slightly exposed, inconspicuously paleaceous; scales dark reddish brown, rigidly acicular, subfalcate, subflexuose toward the tip, 2–4 mm. long, 0.2–0.3 mm. broad, the cell walls richly colored; stipe slender, about 1 cm. long, brownish, alate, passing gradually into the lamina, deciduously pubescent with minute branched glandular hairs; lamina 7–13 cm. long, 5–9 mm. broad, linear, narrowly attenuate in the basal third, a little more abruptly attenuate in the apical part (the extreme apex subcaudate), the margins delicately repand, appearing undulate in drying, bordered by a delicate filiform line of lustrous blackish-brown sclerotic tissue, this bearing a few minute caducous branched glandular hairs, similar hairs extending sparingly to the leaf tissue; veins free, arising at an angle of about 35°, slender, concealed, but their course easily evident, the sterile ones simple; sori oval, extending from below the apex to the middle of the lamina, seated partially or sometimes wholly upon a very short divergent translucent distal spur of the vein, far below its middle, thus borne close to the concealed but sharply elevated slender costa, separate or at maturity subconfluent. Leaf tissue firmly membrano-chartaceous, dark green, paler beneath, the veins easily evident without transmitted light.

". . . Sierra de Naguabo, eastern Porto Rico. . . Hess (no. 312).

"*Polypodium Hessei* is closely related to *P. limbatum* . . ., but differs . . . in its more rigid and darker rhizome scales, in its nearly basal sori, and . . . distinctly stipitate . . . fronds."—Maxon. l. c.

The "minute branched glandular hairs," noted by Maxon on this species and on *P. bryophilum,* are a sparse, caducous scurfiness, hardly related to the simple straight hairs of most species of the genus.

FIG. 107

The species seems to be locally common. Besides the type, I have seen *Blanner 272, Sintenis 1791, Shafer 2328, 3320, 3516, 3584, 3660,* all in Herb. N. Y. Bot. Garden. From Dominica, it is represented by *Ekman H 12282,* in U.S. Nat Herb.

It is indeed close to *G. limbata.* The Dominican specimen, agreeing with *P. Hessei* as to the paleae, has almost sessile fronds. There is little difference in the position of the sori, all being subcostal.

150. POLYPODIUM BRYOPHILUM Maxon

Polypodium bryophilum Maxon, Am. Fern Jour. **16** (1926) 7.

"Rhizome short-creeping, less than 1 cm. long, 2 mm. thick, the apical portion obliquely paleaceous; scales subulate-acuminate, subfalcate, 2–2.5 mm. long, 0.2–0.3 mm. broad, bright green, rigid, thickish, fragile, subentire. Fronds several, subfasciculate, pendent, 8–14 cm. long, the stipe delicate, brown, 3–4 cm. long, bearing a few lax, branched, capitate-glandular hairs, lightly alate upward, passing gradually into the attenuate blade; blades simple and entire, liguliform, the largest 10 cm. long, 8 or 9 mm. broad, evenly attenuate in the basal third, abruptly rounded-acutish at apex, the tip subcuspidate; margins lightly repand in drying, with a narrow border of lustrous blackish-brown sclerotic tissue; costa evident beneath to the middle or beyond, slender, brown, lustrous; veins free, immersed, dark, evident by transmitted light, diverging from the costa at an angle of 40°–50°, the sterile ones simple; sori oval, extending from apex to middle, each terminating or wholly occupying a short oblique distal spur arising one-third the distance from base of vein, thus subcostal. Leaf-tissue firmly chartaceous, sublustrous, at first bearing a few remote, branched, glandular hairs beneath.

"Type in the U. S. National Herbarium, no. 1,181,642, collected from a densely mossy tree trunk above La Palma, on the road to La Hondura, Costa Rica, altitude 1,700 meters, July 17, 1923, by William R. Maxon and Alfred D. Harvey (no. 7980)."—Maxon, l. c.

By Dr. Maxon's courtesy, I have in hand his type, and have nothing to add to or subtract from his description. However, except that the veins stand at a slightly wider angle, and the paleae are just a shade darker, I cannot distinguish it from

Mexia 4063, by which I interpret *G. fluminensis.* The fronds have the apex which Maxon criticised in Fée's illustration.

151. GRAMMITIS QUAERENDA Bolle

Grammitis quaerenda Bolle, Zeits. Allgem. Erdkunde n. Ser. 14 (1863) 324.

Polypodium ebeninum Maxon, Bull. Torrey Club 42 (1915) 224.

"Diagnose: Pusilla, glabra, frondibus simplicibus linearibus integerrimis subsessilibus, apice abrupte acutatis, basi sensim attenuatis, subcoriaceis, nervis secondariis pinnatis, in lamina inferiore frondis prominentibus; soris . . .

"Synonyme: Grammitis linearis, L. v. Buch, Physikalische Beschreib. Canar. p. 138 u. 179, non Swartz.—Webb et Berthelot, in annotatione Phytographiae canar. III. p. 455.—G. graminoides, L. v. Buch in seinem Herbar No. 7."—Bolle, l. c.

To supplement Bolle's inaccurate and inadequate description, I add Maxon's perfect one.

"Plants apparently epiphytic; fronds numerous, 5–10 cm. long, ascending, imbricate-fasciculate in a small crown. Rhizome erect or ascending, 7–10 mm. long, 1–1½ mm. in diameter, paleaceous, the apical portion partially concealed; scales acicular, 2–2.3 mm. long. 0.17–0.25 mm. broad, subflexuose toward the slender gland-tipped apex, rich castaneous from a yellowish brown base; stipe proper nearly wanting, alate, passing gradually into the narrow lamina from a brownish base; lamina 5–9 cm. long, 2–4 mm. broad, straight or slightly arcuate, narrowly linear, acutish or obtuse, broadest in the apical third, thence very gradually long-attenuate to the base, entire, slightly repand, the margin consisting of a slender band of rigid lustrous ebeneous sclerotic tissue, glabrate; veins numerous, free, very oblique, arising at an angle of about 20°, the sterile ones simple the fertile ones essentially so, the sori (usually confined to the apical half of the lamina) distinctly inframedial in attachment, seated upon an elliptical translucent receptacle lying upon the distal side of the vein and scarcely divergent from it, relatively large, crowded against the costa, the two lines of sori more or less confluent at maturity. Leaf tissue glabrous, rigidly herbaceous, translucent, dark green above, paler beneath; veins readily seen beneath without transmitted light.

"Type in the U. S. Nat. Herb. no. 370659, collected upon the island of St. Helena, 1885, by W. H. King."—Maxon, l. c.

Maxon noted that Kuhn, Fil. Afric. (1868) 149, had identified the Teneriffe and St. Helena plants, both as *P. marginellum,* which, reasonably enough, did not deter him from describing the latter as new. However, Reimers, Notizbl. Berlin 11 (1933) 930, has compared these two in the light of Maxon's publication, and states: "Mit der St. Helena-Pflanze stimmt . . . das einzige von den Canaren . . . bekannt gewordene

FIG. 108

Exemplar . . . vollständig überein"; and this judgment must in reason be accepted, in spite of his disposition to reduce both to *G. fluminensis.*

Besides Maxon's type, I have seen *Burchell 185, Haughton 905,* and *Walker s. n.,* all in the Gray Herbarium, from St. Helena.

In St. Helena, this seems to be a very uniform little plant, nearest to *G. fluminensis,* distinguished by the fine but evident venation as well as by the position of the veins. The sorus completely occupies an acroscopic branch, at so acute an angle to the basiscopic that they are as near as possible to parallel.

As to the very narrow angle at which the veins leave the costa, on which Maxon placed particular emphasis, this is correlated with narrowness of frond; and the specimens from western and northern South America which I leave in *G. fluminensis* are like *G. quaerenda* in this respect. In treating *G. quaerenda* as distinct, I am not obliged, as Reimers would have been, to make any new combination.

152. POLYPODIUM MELANOLOMA Cordem.

Polypodium melanoloma Cordem., Fl. Réunion (1895) 83.
"Grammitis Boiv. MSS.

"Souche fine, couverte de petites écailles brunes, rampant sur les vieux arbres moussus.

Pétiole très court, presque nul, glabre. Fronde cunéiforme à la base et faisant suite, sans ligne de démarcation, au pétiole, très courte, 2–3 cent. de long., ⅛ de large, glabre, arrondie au sommet, coriace, veines pinnées a peine visibles, bords épaissis en bourrelet noir. Sores allongés, volumineux.

"Très distincte. Rare. Sur les vieux arbres; a la plaine des Cafres, près de la Grande-Montée."—Cordemoy, l. c.

Not seen. Mme. Tardieu-Blot could not find a specimen in Paris.

152a. POLYPODIUM MICROGLOSSUM C. Chr.

Polypodium microglossum C. Chr. Perrier Cat., *nomen;*
Pterid. Madag. (1932) 149, *pl. 56, fig. 1–2.*

"*Grammitis P. marginello* Sw. affinis, pusilla, paleis rhizomatis brevis rufo-castaneis, linearibus; foliis dense fasciculatis, sessilibus, spathulatis, maximis 1 cm. longis, supra medium 2–2.5 mm. latis, apice late rotundatis (interdum apiculatis), versus basin sensim angustatis, glaberrimis, coriaceis, marginibus scleroticis crassis nigris; venis parum visibilibus, paucis, 1–4-jugis, obliquis, marginem non attingentibus, sterilibus simplicibus, superioribus fertilibus supra basin ramo antico brevissimo sorifero instructis; soris superficialibus, oblongis, maturis costam tegentibus.

"Massif de Manongarivo, cime très sêche, vers 1200 m. d'alt. parmi les lichens, Mai 1909 (Perrier 7474, type in Herb. Bonaparte).

"Bonaparte was no doubt wrong in referring these very small specimens to the West-Indian *P. marginellum* Sw. which is hairy and the veins all forked. The species is much more closely related to *P. ebeninum* Maxon from St. Helena, from which it differs by its very much smaller spathulate fronds, less distinct and less oblique veins."—C. Chr., l. c.

Not seen.

153. GRAMMITIS VAUPELII (Brause) Copel., comb. nov.

Polypodium Vaupelii Brause, Notizbl. Berlin **8** (1922) 140.
Polypodium marginellum Baker, Jour. Bot. **14** (1876) 12, *non* Swartz.

"*Eupolypodium* e *P. nigrolimbati* (Spruce) Jenman affinitate. Rhizoma erectum, ramosum, paleis fuscis nitidulis linearibus acuminatis, usque ad 0.9 cm longis basi 0.6 mm latis, margine integris instructum, folia fasciculata subpetiolata emittens. Petioli fusci, nitentes subglabri, usque ad basin angustissime alata, 1–2 cm longi, 0.4–0.6 mm crassi. Lamina ambitu linearis utrinque succedaneo-attenuata, apice obtusiusculo, margine integro brunneo-limbato, papyracea utrinque subglabra, usque ad 30 cm longa, 0.5 cm lata. Nervus medianus petioli similis teres subglaber, nervis lateralibus angulo acutissimo insidentibus crassis emersis, subconfertis, laminae marginem non attingentibus, sterilibus simplicibus, fertilibus ramulum soriferum emittentibus. Sori dimidiam vel tertiam laminae partem occupantes ambitu oblongi, nervio medio approximati, maturitate confluentes nervumque medium occultantes sed laminae apicem 2–4 cm longum negligentes.

"Samoa-Ins.: Savaii, Kammgebiet, 1000 m. ü. M. (Vaupel n. 436—1905).

"Die Art zu der Gruppe der Polypodien gehörig, deren einfache Blätter wie mit dunklem Draht, der sich bei dem trockenen Blatt sehr leicht ablöst, eingerahmt erscheinen, ist dem zu derselben Gruppe gehörigen *P. nigrolimbatum* sehr ähnlich, untesrcheidet sich aber hauptsächlich durch die gut sichtbare, stark hervortretende und enger gestellte Aderung."—Brause. l. c.

The only specimen I have seen in *Christophersen 757*, in the Bishop Museum, juvenile, too immature for judgment. It indicates no real difference from *P. marginelloides* except that the fronds are very narrow.

153a. POLYPODIUM MARGINELLOIDES J. W. Moore

Polypodium marginelloides J. W. Moore, Bishop Mus. Bull. **102** (1933) 10.

"Rhizoma breve repens vel suberectum radicibus plurimis gracilibus squamisque nitidis rufo-fuscis vestitum, squami ad 8 mm. longi ¾ mm. lati ex basi ad apicem apiculatum sensim attenuatae, folia ad 15 cm longa 7 mm lata simplicia (raro furcata) sessilia linearo-lanceolata, super medium latissima hinc ad basin sensim attenuata et super partem soros ferentem angustata in apicalem laciniam sterilem obtusam 2–2½ cm. longam, margines foliorum crassatae rufo-fuscissimae pilis brevibus furcatis glandulosis instructae (ut eitam sunt costae infra nervi sursum arcuati simplices vel interdum furcati plerumque prope suas extremas apicales interdum apicibus nervorum proximorum adjunctis, sori in parte

tertia foliae superiore infra partem contractam apicalem et prope costam sublati elliptici circa 1 mm. lati, sori juniores distincti seniores confluentes, sporangia sine appendicibus 207 x 199 μ, sporae rugosae 26 x 26 μ.

"Field number 108, September 21, 1926, altitude 470 meters; on moss-covered *Pandanus* branches, Temehani Plain. Endemic. (Tahiti)

"*Polypodium marginelloides* differs from *Polypodium marginellum* Swartz in having caudate, sterile tipped fronds, shorter stipes, more numerous, closely placed, and less branched veins, inconspicuous cilia on the margins, and larger paleae. From *Polypodium Hessei* Maxon it differs in having upwardly arched veins, a more attenuate sterile tip, and different paleae."—Moore, l. c.

Mumford and *Adamson 586,* from Nukuhiva, Marquesas, contains one plant of a *Melanoloma,* with fronds at most 6 cm long in good fruit. The size may hardly be a specific character. It may be *G. Vaupelii,* or *P. marginelloides,* or both, or neither.

COMMENT ON MELANOLOMA

This subgenus is a natural entity, but falls into geographic subgroups. The Pacific subgroup is well distinguished by large paleae. There is no such conspicuous general distinction between the American and African subgroups; but they have no common species, and it is easier for me to believe that they migrated independently from the South than that one continent colonized the other in the tropics. As both regions have species with long and with short fertile veinlets, it seems probable that differentiation in this respect antedated the northward migration.

The group with elongate fertile veinlets is represented by two species in each region. *G. marginella* is well known in Jamaica and in Costa Rica, not exactly alike in the two areas; and is represented by one Haitian collection. *G. leptopoda* is known by only two collections in northern South America. The dependable distinction between the two species is the relative nakedness of *G. leptopoda,* but the long stipes of specimens of *G. leptopoda* are more conspicuously peculiar. The two African species are alike distinct from *G. marginella* in the character of their pubescence,—weak pale, septate hairs. On the stipe of *G. kyimbilensis,* some of these hairs are branched.

The American species with very short fertile branches are commoner, more wide-spread and less distinct. The first described was *G. limbata,* from Guadalupe; the next, *G. fluminensis* from Rio Janeiro. More recently, *P. nigrolimbatum* (as a substitute name, and ascribed to the entire area), *P. Hessei* from Porto Rico, *P. bryophilum* from Costa Rica, and *P. haplophle-*

ium from Venezuela have been described. The last three are more or less well defined local strains, about as distinct as is *P. nigrolimbatum* of Jamaica from the original *G. fluminensis* of Rio. I have abstained from the transfer of any of these names, not because I cannot recognize them as weakly definable local species while the variability of all of these species is ill known, nor because I would criticise their publication, but because I find it difficult, with the material in hand, to be sure of a difference between *G. limbata* and *G. fluminensis,* and suspect that with much more ample collection it may prove impossible to distinguish any of the other species from *G. limbata.* For the present, I prefer not to be responsible for new names, but present these "species" as they have been published.

G. quaerenda of St. Helena and Teneriffe seems to be distinct, but related to the American species rather than to the African.

I have seen neither of the African species described as with short or abortive fertile veinlet; but the first published of these, *P. melanoloma,* is so insufficiently described that a distinction between them remains doubtful.

The two species described from Polynesia are conspicuously unlike those of any other region, in having paleae 8 to 9 mm. long. The distinction between the two is subject to question.

ILLUSTRATIONS

PLATE 1

Grammitis crassa Fée.

PLATE 2

FIG. 1. *Grammitis turquina* (Maxon) Copel.; type.
2. *Grammitis graminea*, for comparison.

PLATE 3

Polypodium minusculum Maxon; type.

PLATE 4

Glyphotaenium spongiosum (Maxon); type.

PLATE 5

Grammitis habbemensis Copel.; type.

PLATE 6

Grammitis ludens (Baker) Copel.; isotype in U. S. Nat. Herb.

TEXT FIGURES

[Text figures were drawn three times natural size, unless otherwise stated]

FIG. 1. *Grammitis Billardieri* Willd., ex herb. *Labillardiere.*
2. *Grammitis crassa* Fée. Aston.
3. *Grammitis graminea* (Swartz) Copel.; probable isotype.
4. *Grammitis turquina* (Maxon) Copel.; type, X 6.
5. *Grammitis Tatei* Copel., nom. nov.; isotype, receptacle on left, X 6.
6. *Grammitis furcata* Hooker and Grev., *Ule 8515.*
7. *Grammitis wittigiana* Fée, l. Brade; receptacles on left.
8. *Grammitis jungermannioides* (Kl.) Copel., l. Standley.
9. *Polypodium yarumalense* Hieron; l. Maxon.
10. *Grammitis trifurcata* (L.) Copel., l. Sintenis.
11. *Grammitis minuscula* (Maxon) Copel., isotype.
12. *Grammitis Poolei* (Baker) Copel., l. Forsyth—Major.
13. *Grammitis diminuta* (Baker) Copel., l. Watts.
14. *Grammitis* Wattsii Copel., isotype.
15. *Grammitis nudicarpa* Copel.; type.
16. *Grammitis neocaledonica* Copel., type.
17. *Grammitis Deplanchei* (Baker) Copel.; l. Franc.
18. *Grammitis hirtelloides* Copel.; type; receptacles on left.
19. *Grammitis conformis* (Brack.) J. Smith; l. Christophersen.
20. *Grammitis Christophersenii* Copel., type.

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FIG. 21. *Grammitis insularis* Copel., type; sporangia have been lost.
22. *Grammitis Whitmeei* (Baker) Copel., *Vaupel 437.*
23. *Grammitis samoensis* (Baker) Copel., *Christophersen 3543.*
24. *Grammitis tahitensis* (C. Chr.) Copel., *MacDaniels 1546.*
25. *Grammitis trachycarpa* (Mett.) Copel., l. Grant; receptacles on left.
26. *Grammitis subspathulata* (Brack.) Farwell, l. Grant.
27. *Grammitis Baldwinii* (Baker) Copel., l. Rock.
28. *Grammitis tenella* Kaulf., broad frond.
29. *Grammitis miltiblepharis* Copel.; isotype.
30. *Grammitis Maireaui* Copel.; isotype.
31. *Grammitis ponapensis* Copel.; isotype.
32. *Grammitis scleroglossoides* Copel., isotype; receptacles on left.
33. *Grammitis caricifolia* Copel.; type.
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37. *Grammitis graminifolia* Copel.; l. type.
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39. *Grammitis subfasciata* (Ros.) Copel.; isotype.
40. *Grammitis pleurogrammoides* (Ros.) Copel.; isotype.
41. *Grammitis interrupta* (Baker) Copel., l. Brass, X 5.
42. *Grammitis plurisetulosa* Copel., type; receptacles on right.
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44. *Grammitis dictymioides* Copel.; type.
45. *Grammitis locellata* (Baker) Copel., l. Clemens.
46. *Grammitis stomatocarpa* Copel.; type, narrow frond., soral slits on right.
47. *Grammitis scabristipes* (Baker) Copel., l. Clemens.
48. *Grammitis novoguineensis* Copel.; type.
49. *Grammitis coredrosora* (v.A.v.R.) Copel.; isotype.
50. *Grammitis parva* (Brause) Copel., *Schlecter 17156,* X 6.
51. *Grammitis mesocarpa* (v.A.v.R.) Copel., l. Brass.
52. *Grammitis sumatrana* (Baker) Copel., l. Copeland, receptacles on left.
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54. *Grammitis subreticulata* Copel.; type.
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56. *Grammitis ciliolata* (v.A.v.R.) Copel.; isotype.
57. *Grammitis dolichosora* Copel.; type.
58. *Grammitis Mariae* Copel.; type.
59. *Grammitis hirtiformis* (Ros.) Copel.; isotype, receptacles on right.
60. *Grammitis matapensis* Copel.; type
61. *Grammitis debilifolia* Copel.; type.
62. *Grammitis Myer-Dreesii* Copel.; type.
63. *Grammitis brevisetulosa* Copel.; type.
64. *Grammitis habbemensis* Copel.; type.
65. *Grammitis ornatissima* (Ros.) Copel.; isotype.
66. *Grammitis trogophylla* Copel.; type, hairs removed on right.

FIG. 67. *Grammitis cyclosora* Copel.; type.
68. *Grammitis trichopoda* (Mueller and Baker) Copel.; *Brass 4260.*
69. *Grammitis nigropaleata* Copel., type, *Clemens 41018*, hairs removed on right.
70. *Grammitis fasciculata* Blume; type.
71. *Grammitis murrayana* (C. Chr.) Copel., l. Clemens.
72. *Grammitis knutsfordiana* (Baker) Copel.; l. Brass.
73. *Grammitis hispida* Copel.; type.
74. *Grammitis fasciata* Blume; type, receptacles on right, sori on left.
75. *Grammitis padangensis* (Baker) Copel.; type of *Polypodium durum, Elmer 11689.*
76. *Grammitis ceramica* (v.A.v.R.) Copel.; isotype, showing shape of receptacles; sori are round-oblong.
77. *Grammitis loheriana* (Christ) Copel., l. Bacani.
78. *Grammitis adspersa* Blume; type.
79. *Grammitis kinabaluensis* Copel.; isotype.
80. *Grammitis stenocrypta* Copel., type, soral pits on right.
81. *Grammitis congener* Blume; type.
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83. *Grammitis limapes* Copel.; type.
84. *Grammitis bulbotricha* Copel.; type.
85. *Grammitis jagoriana* (Mett.) Copel.; l. Copeland.
86. *Grammitis hirtella* (Blume) Copel.; l. Copeland (Gedeh).
87. *Grammitis ludens* (Baker.) Copel.; isotype.
88. *Grammitis Holttumii* Copel.; type, hairs removed on left.
89. *Grammitis peninsularis* Copel., small frond, *Holttum 23701.*
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92. *Grammitis Asahinae* (Ogata) Ito, l. Ogata.
93. *Grammitis Reinwardtii* Blume, l. Copeland (Gedeh).
94. *Grammitis setosa* Blume; type, receptacles on left.
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97. *Grammitis Stresemannii* Copel.; type.
98. *Grammitis obscura* Blume; type, setae mostly lost.
99. *Grammitis marivelesensis* Copel.; type *Copeland 215.*
100. *Grammitis pilosiuscula* Blume; type of *Grammitis hirta* var. B, cf. Flora Javae, *pl. 47, fig. 1B.*
101. *Grammitis Havilandii* (Baker) Copel., *Topping 1711*, hairs omitted on right.
102. *Grammitis Frederici* et Pauli (Christ) Copel., *Bunnemeyer 12067.*
103. *Grammitis marginella* Sw., l. Underwood.
104. *Grammitis kyimbilensis* (Brause) Copel.; type, fragment.
105. *Grammitis limbata* Fée, l. L'Herminiere, Guadaloupe.
106. *Grammitis fluminensis* Fée, l. Mexia.
107. *Polypodium Hessei* Maxon, *Shafer 3516*, receptacles on left.
108. *Grammitis quaerenda* Bolle, l. Haughton, St. Helena.

PLATE 1.

PLATE 2.

PLATE 3.

PLATE 4.

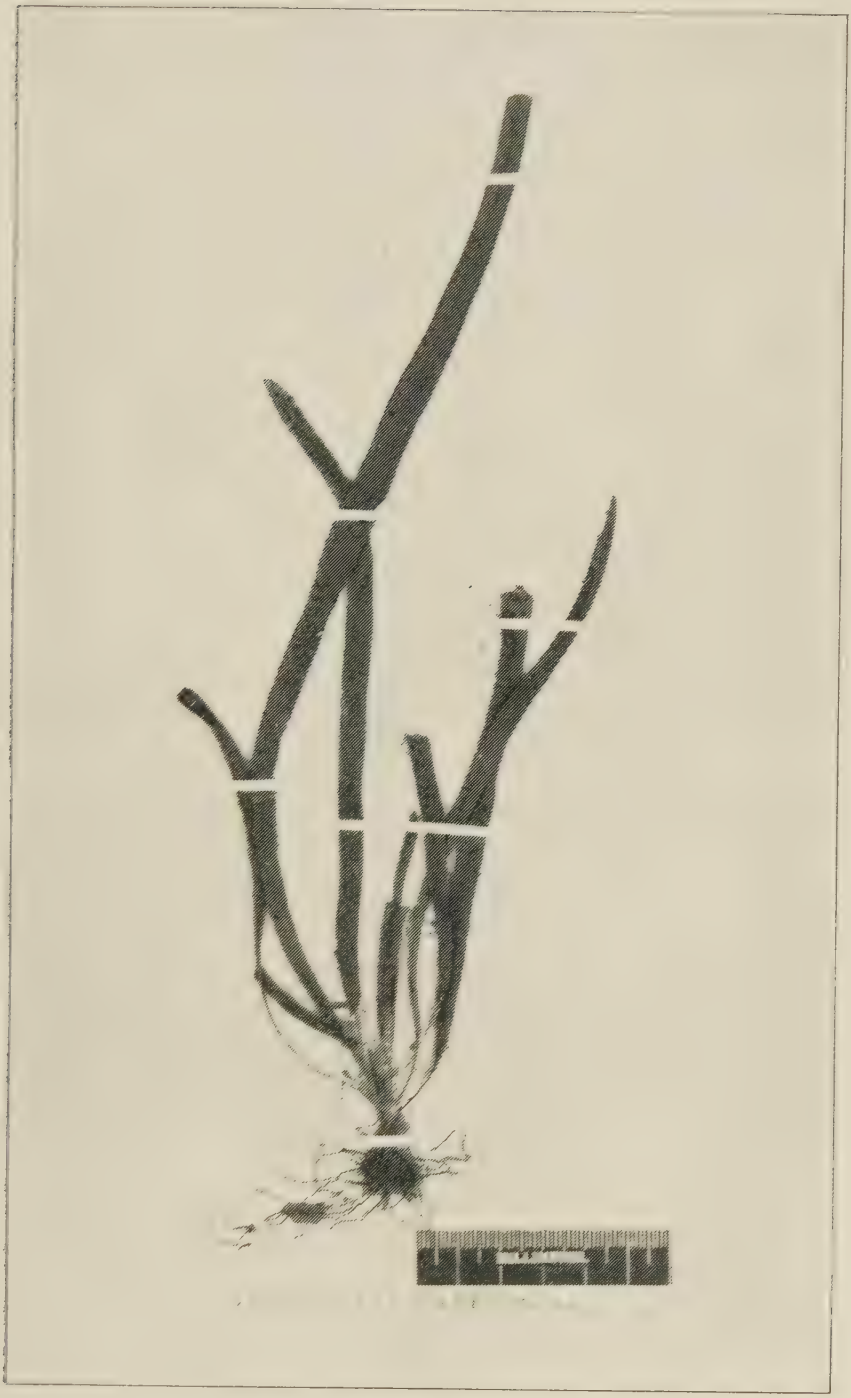

PLATE 5.

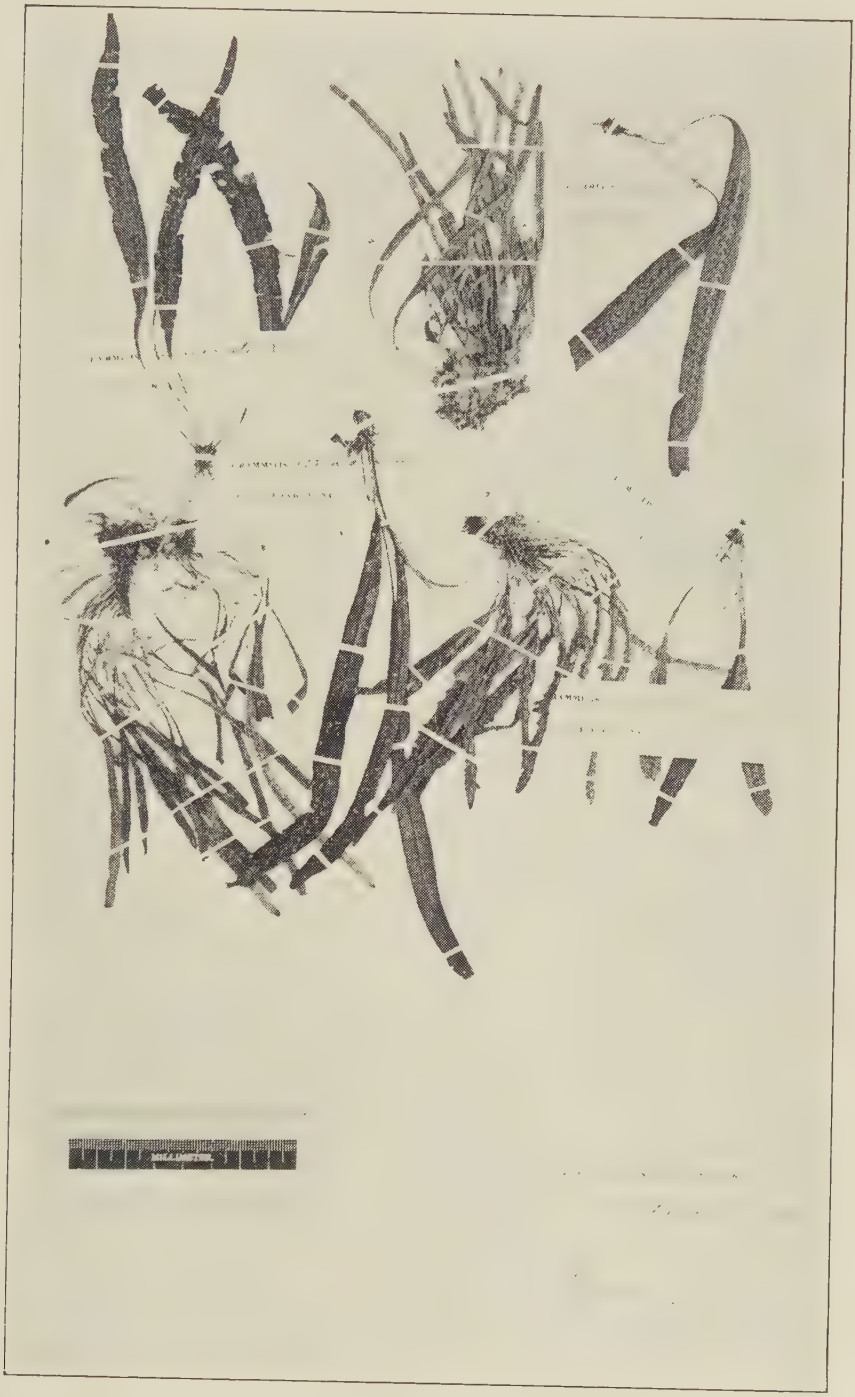

PLATE 6.

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BOOKS

Intermediate Algebra for Colleges. By Paul R. Rider, New York, The MacMillan Company, 1949. 242 p. Price, $2.75.

The content is adequate for the purpose for which it is intended. The order and method of presentation of the subject matters are logical, simple, complete and easily understandable. The examples given are adequate to illustrate the application of the principle developed; the solutions of the examples are varied, simple and complete, giving the student a variety of ways in the use of the principles presented and developed. The exercises for solutions are sufficiently graded to serve as a good challenge to the minds of the students. The problems are a variety of well correlatively arranged tests calculated to stimulate the interest and develop the thinking power of the student.

The book is very ideal for use in college work, especially for those who intend to teach mathematics or who wish to develop further their proficiency in mathematical skill.—F. V. E.

An Introduction to the Embryology of Angiosperms. By P. Maheshwari. 1st ed. New York, McGraw-Hill Book Company, Inc., 1950. 453 p. Price, $6.00.

This book is divided into 13 chapters and is essentially a summary of the existing state of knowledge of the embryology of angiosperms. The author's long experience as professor of botany and his many contributions to the science of embryology stamp this book as authoritative. The extensive bibliography which appears at the end of each chapter and the numerous illustrations which are included in the text make one feel that it is really a compact compendium of valuable information on angiosperm embryology.

The text begins with a historical sketch of the progressive development of the science of embryology from early times to the present century. For a wider and clearer comprehension of embryology, the author precedes his discussion of the formation of the embryo and endosperm with an account of the nature and developmental processes of the male and female gametophytes and of the events which lead into gametic fusions and on to fertilizations. After clearly demonstrating the development of

the endosperm and the embryo he continues on with the description of the different types of "apomixis," an asexual process of reproduction which is prevalent in certain angiosperms and then with an enumeration of the different cases of polyembryony, a phenomenon which is fairly widespread in the same group of seeded plants. In the chapter dealing with "embryology in relation to taxonomy" the author emphasizes the value of embryological data in clarifying points of obscurity in demonstrating the interrelationships of families and genera. Following this is the chapter on "experimental embryology," a new field of study wherein the geneticist, physiologist, cytologist and embryologist all find a common ground. This new field according to the author "promises to offer many opportunities and openings for the future." The book concludes with a discussion of origin and homologies of the male and female gametophytes and endosperm and also of the relationship of monocotyledons and dicotyledons based on the development and organization of the male and female gametophytes and endosperm.

The book, in general, will be found very useful for both teachers and students of botany and will be a valuable addition to any botanical or any scientific library. It is well written on glazed paper and is easy to read as the prints are clear.—M. A. P.

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